BRITISH COLUMBIA LAND FOR WILDLIFE
Past, Present, and Future

BC
Ministry of
Environment

BRITISH COLUMBIA LAND FOR WILDLIFE
PAST PRESENT FUTURE

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CONTENTS

OPENING REMARKS

The Honourable Stephen Rogers, B.C. Minister of Environment 1

Dr. Dick Stace-Smith, President, Federation of B.C. Naturalists 2

Mrs. Diane Griffin, Past President, Canadian Nature Federation 4

GLOBAL, NATIONAL, AND PROVINCIAL OVERVIEW

Land For What? Are You Kidding?
Yorke Edwards 6

Faunal Diversity as a Habitat Goal
Ian McTaggart Cowan 20

GOVERNMENT POLICIES AND PROGRAMS

Some Past History, Current Practices, and Future Needs
W. Arthur Benson 31

Strategic Planning for Wildlife in B.C.
John H. Dick 39

Crown Land Allocation and Management: the Implications for Wildlife
R.H. Ahrens 52

Ministry of Forests' Participation in Wildlife Habitat Management
C.J. Highsted 59

Migratory Bird Habitat Preservation in British Columbia and the Yukon Territory
Laszlo Retfalvi 64

THE RACE FOR SPACE

Evolution of Wildlife Habitat Evaluation and Mitigation Practices Used by B.C. Hydro
R.M. Bradley 69

Wildlife Management and Land Use: "How Are We Faring in the Race for Space"
D.J. Robinson 73

The National Second Century Fund of B.C.: A Growing Gift
Pamela M. Cowtan 78

The Role of Ducks Unlimited in Waterfowl Habitat Preservation in B.C.
Tom Slater 86

CURRENT PROBLEMS

Cattle-Wildlife Interactions
Jim White 90

Forest Succession and Wildlife in Wells Gray Provincial Park
R.W. Ritcey 94

Caribou in Crisis
Goeff B. Swannell 99

An Option Pertaining to Flooding the Peace River Valley
Leo Rutledge 104

Industrial Development in the Northwest: Facing the Challenge
Bob Henderson 108

Wildlife and Land: The Vancouver Island Example
F.L. Bunnell 111

Implications of Forest Tenure for Wildlife Management in Coastal Ecosystems
D.M. Hebert 131

Waterfowl Habitats of the Lower Fraser Valley Wetlands
Barry Leach 136

Land: Our Life, Our Living
Carmen C. Purdy 151

British Columbia: Valley Bottoms and Mountain Tops
R.A. Demarchi 154

STRATEGIC WILDLIFE HABITAT PLANNING

Accounting for Wildlife Habitats in Managed Forests
Jack Ward Thomas 159

Communications in *Orcinus orca* (killer whale)
Alexandra Hubbard-Morton 174

LIST OF PARTICIPANTS 176

OPENING REMARKS

THE HONOURABLE STEPHEN ROGERS

Minister of Environment, Province of British Columbia
Victoria, B.C.

I appreciate being asked to join you again this year and I am particularly pleased that my ministry was able to assist in organizing this conference.

Since my address last year we in the Ministry of Environment have undertaken a number of initiatives that reflect the intention of the ministry to live up to its mandate to provide a quality environment in B.C. for the people and fish and wildlife.

One initiative that we are particularly proud of is the creation of the Habitat Conservation Fund and the purchase of the first three parcels of key habitat for fish and wildlife under the auspices of the fund. These three parcels of land total 1471 acres. Near Antlers Saddle, north of Summerland, we have acquired 615 acres of critical wintering habitat for mule deer. Thirty-miles north of Kamloops on the west side of the North Thompson River we have purchased 640 acres. Again this is critical winter habitat for mule deer. Two hundred and sixteen acres of river-front property on the south side of the Stellako River southwest of Fraser Lake have been obtained to control key habitat for rainbow trout, sockeye, and chinook salmon.

I expect to announce further acquisitions later this year.

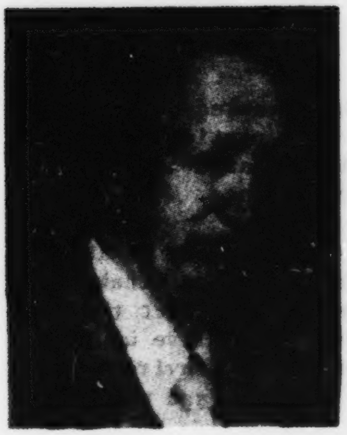
We are all aware, I am sure, that while British Columbia is blessed with tremendous natural resources, we are at the point in our development where we have competing uses for the same land base. Attempts have been made over the past decade to integrate land and resource use through a variety of planning processes. We have made progress, not as much as we might like, but we have learned that some pieces of land can only support one major use at any one time.

The challenge of this decade--the 1980's--will be to introduce optimum use rather than a combination of uses in a single piece of land. This will be especially true of resources such as wildlife.

The agenda today includes other programs and projects in which the ministry is involved or has a major interest. I trust we all benefit from the exchange of information.

RICHARD STACE-SMITH

President, Federation of British Columbia Naturalists
1200 Hornby Street, Vancouver, B.C. V6Z 2E2



Mr. Chairman, Dr. Pedersen, the Honourable Stephen Rogers, Ladies and Gentlemen:

It is indeed a pleasure for me to bring greetings on behalf of the Federation of British Columbia Naturalists. I was impressed with the keen interest shown in the keynote speech delivered by Yorke Edwards last evening and have every reason to believe that today's program will be equally interesting and exciting. The Federation, as one of the sponsors of this symposium, is indeed gratified by the response, not only in terms of the number in attendance but also in terms of the broad cross-section of interests and disciplines represented here this morning.

As I mentioned last evening, this is the second symposium that the Federation has co-sponsored over the past two years. The first "Threatened and endangered species and habitats in British Columbia and the Yukon" was held in March, 1980. That one was co-sponsored by the Federation, the Institute of Environmental Studies, Douglas College, and the Fish and Wildlife Branch, B.C. Ministry of Environment.

For me personally, there is another distinct difference between this symposium and the previous one. I was directly involved in organizing the previous one whereas with this one my involvement has been minimal. However, I know what is entailed in drawing up a program, contacting speakers, adjusting to program changes as the planning develops, and innumerable other details. For this reason, I would like to take this opportunity to publicly thank those who worked so hard to organize this symposium. While many individuals were involved, the two who were most involved were Chad Day from Simon Fraser University and Natalie Minunzie from the Federation. On behalf of the assembled audience, I would like to express our gratitude to Chad and Natalie.

If you check the back page of the official program you will see that Bert Brink and Rod Silver were the other two members of the program committee. I see Rod in the audience this morning and I regret that Bert was not able to be here. As many of you know, Bert Brink was President of the Federation until a few months ago. He is also a highly respected plant scientist who is presently in Kenya advising on agricultural projects sponsored by the Canadian International Development Agency. I am sure that Bert would prefer to be back in Canada this weekend, participating in this symposium, a symposium that he has nurtured and encouraged for the past year.

I am sure we all recognize the importance of the land base when considering the past, present and future of wildlife in this province. I think it is an appropriate and timely subject and I am pleased that the program committee has attracted an excellent slate of speakers. I would hope that we not only identify some of the major problems respecting wildlife habitat in the province but also that we identify possible solutions to these problems.

DIANE F. GRIFFIN

Past President
Canadian Nature Federation

First of all, I must say that I'm very pleased to have been asked to address opening remarks to this conference on behalf of the Canadian Nature Federation. Two other members of the Board of Directors, Joe Lotzkar and Rosemary Fox, are also in attendance.

It's good to see that the Honourable Steve Rogers is still forging ahead and representing environmental interests at the cabinet level. When I first met him at the British Columbia Wildlife Federation's annual conference in April 1981, he was already one of the longest-lived environment ministers in the recent history of the province.

Upon receiving a copy of the conference agenda, one fact that made an immediate impression was the number and variety of groups and individuals represented on the program. Since I am the only "imported" speaker, it is equally impressive that all of this talent was drawn from one province. Also, it is a sign of the times in that conservation groups are developing much better lines of communication among themselves than has existed until recently. We are all finding that we need each other's support in the face of what seems at times like overwhelming odds against us. There are increased pressures from all potential resource users, many of which are well equipped with money for development as well as expertise and political influence in promoting their proposals. Thus, it has become necessary for conservation groups to spend less time dwelling on our differences and to get on with fighting for the major concepts for which we all stand.

From a national viewpoint, I must say that it is particularly gratifying to see our provincial affiliate, the Federation of British Columbia Naturalists, working in co-operation with the B.C. Wildlife Federation, the Sierra Club, and others on many conservation issues. We are all consumers of wildlife and its habitat even if we happen to be birdwatchers who generally do not think of this activity as being consumptive. By our very presence in enjoying nature, we make some impact upon it. In most of Canada, however, I believe we are in little danger of loving nature to death at this time.

There have been many ways in which groups, individuals, and government agencies have played roles in the conservation of wildlife. For example, British Columbia was the leader in Canada in enacting ecological reserves legislation in 1971. However, this very important program is only part of the conservation jigsaw puzzle. It is the cumulative effect of all efforts that will determine the survival of wildlife in some semblance of its habitat as we know it today. As York Edwards expressed it last night in his keynote address--it all boils down to land. We can talk about it all we want, but there has to be some translation into action. In this context, I am particularly pleased that this conference will be followed up with resolutions to focus attention on areas of concern. Each of these should be pursued until we receive a satisfactory response from the agency to which it is to be addressed.

Again, thank you for inviting the Canadian Nature Federation to participate in this conference.

GLOBAL, NATIONAL, AND PROVINCIAL OVERVIEW

LAND FOR WHAT? ARE YOU KIDDING?

YORKE EDWARDS

Director, Provincial Musueum, Victoria, B.C.

The Accelerating Retreat

The wildlife of the world is being destroyed at an alarming rate, and this is because the places that wildlife must have to survive are being destroyed. The cause of it all is people, people in billions, people all wanting the good life like in America, people with the new technology to destroy land, people converting their landscapes into comic books, champagne, and mink-handled toothbrushes.

People like us.

I can also hear some of your thinking: what have I come for? This is another damned doom and gloom speech on conservation, trying to save the world with words. Well, you are at least partly wrong. I am not dedicated to saving all the world's wildlife, nor British Columbia's either, because from my point of view many species of the world's wildlife cannot be saved. No rational person should waste time trying to do the impossible. Like the facts of gravity, the cold of winter, and the dark of night, all of which I may dislike but accept happily enough while countering them when I can, I accept that trends all over the world today clearly indicate that the only other life on this planet that will survive with man's billions will be those that can either live with man, or live in the wastelands created by man. There will be no really wild places; therefore there will be no really wild wildlife.

In beautiful British Columbia all this is hard to believe. But remember, we are on one of the last frontiers of wild land in a temperate climate. And if you look closely, our own destruction of the original condition of land, sea, air, and wildlife is impressive and gathering speed.

Many of us in British Columbia are here because it is one of the last frontiers. Some want to experience the boom economy based on destroying the wilderness, cashing in on nature's long accumulations of virgin timber, unexploited salmon, bulldozer coal, the easiest minerals, rich new soils. Others, like me, are here to enjoy the wildness before it all goes. I am a refugee from Ontario, a place covered with signs saying "Private, Keep Out"; a place owned entirely, it seems, by farmers, municipalities, gravel pit companies, loggers, and cottagers.

The world's wildlife versus people conflict is a simple cause and effect situation. People are multiplying like rabbits, each person needing resources from the world to just survive, and most of them wanting 10 to 20 times that acceptable minimum amount of earth's resources so they can live like North Americans--like us!

The result, taking place now, is possibly to become the biggest reduction in kinds of life to take place on Earth since life first covered it in the green of plants, then animated the green with the movement of animals. Seen from afar, what is happening to this rock in space looks like what happens to an apple if you leave it on a fence post. In a perfectly natural process, organisms of decay change it. First small brown spots show on the living green skin, then the spots enlarge, and join and finally the whole surface becomes a brown wreckage of its former condition. Life is still there, but the kind of life has changed.

If there is a villain behind the changes on Earth, it is not individual men. It is man in mind-boggling abundance that is the villain. British Columbians have trouble understanding what is happening to the world's human population. We live on an almost empty frontier, in a rather empty nation. It helps to remember that the whole of this province has a population about the same as that of Toronto--and Toronto is not one of the world's big cities.

Detailed population statistics can be quite pointless because most of us cannot judge the relative sizes of numbers once they go above the thousands. But it is important that we do glimpse the magnitude of the people explosion, because almost all our wildlife problems are caused by it. We know that the people on this little planet now number about 4 billion give or take a few 100 million. Four billion! No one can really understand such a number; but it helps to think of this:

- one hundred seconds is about 1-1/2 minutes
- one thousand seconds is about 17 minutes
- one million seconds is about 12 days
- one billion seconds is about 30 years
- four billion seconds is about 120 years.

Think how short a second is; think how long 120 years is.

Briefly, there is another way of looking at 4-billion people. If you counted them, working an 8-hour shift and a 5-day week, counting one person per second, you would have the present world population counted in 540 years. But by that time you would have perhaps another 30 billion more people to go. The rate of population increase would have greatly exceeded your rate of counting if current levels of growth had continued.

Imagine the daily demand of food alone for 4 billion mouths and the daily need of energy to cook that food. Mind boggling. This, ladies and gentlemen, is the competition for lands for wildlife. And this is the demand that will win, for man will always give top priority to his own tomorrow's food, tomorrow's heat, tomorrow's shelter, and almost always, I fear, to tomorrow's luxuries as well.

World trends in wild lands, and therefore in their wildlife, are much the same everywhere including across Canada. Forests are vanishing, or being kept forever juvenile to maximize cellulose production. Even in Canada, this is happening in some parks. Grasslands are being grazed by livestock, and overgrazed into wastelands, an obvious world trend. Agricultural soils are probably the best treated, but over half are declining in fertility, and most in high production now receive fertility treatments far too costly to sustain. So called fresh waters almost everywhere are dilute sewage. The seas, the great last wild frontiers, are being sieved out for their life and soon will have their bottoms vacuumed for minerals. Such indignities. Even in the darkest Africa I grew up knowing was there, the game animals now survive mainly in parks where you are lucky to find a lion not hidden by Land Rovers and Volkswagens full of tourists. This is a wild park? This is wildlife? The zoos are beginning to look better, even though they have always bothered me.

When stone age man shaped a stone into a useful tool, he made an artifact. An artifact is a man-shaped or man-made object. This small green planet is now an artifact, a man-shaped object.

Man is just about everywhere. Man's influence is everywhere. Put a few stone-age men into a wild landscape, and nothing much happens. Enter technological man in numbers, all aspiring to affluence, and that is the end of wildness. No wonder we have so called wildlife problems.

The cross-Canada condition is simply part of the world conditions. There is nothing special about the coast to coast scene except that while there are places winning some wild land battles, everywhere they are losing the war. The biggest exceptions are where the cold north and the western mountain barrier have slowed down the otherwise rapid European invasion and domination of the country. Signs everywhere point to continuing retreats on all fronts, especially in the north and in the mountains where the battles have been the biggest, because there is still most to lose in these environments.

So much for the cause. Now for a few dimensions of the problems.

The Sayward Scenario

There are two kinds of wildlife, one thriving in the new landscapes made by man smashing the old ones, the other unable to live in man-made places. The deer of this coast, the blacktailed, is a good example of a species that thrives in some places changed by man. And this gives me a chance to tell you a British Columbian story that is not well known, of deer in the Sayward Forest. It illustrates how successful some wildlife will probably always be.

When Europeans first invaded British Columbia, most of the coast was deep in green forests of trees so big they were the wonder of the world. The assault on the wooden wealth, just there for the taking, not having to grow it, began at once.

Between the Strait of Georgia and the mountain spine of Vancouver Island, from Courtenay to Campbell River and beyond, was a coastal plain next the strait. Then rising to the foot of the mountains there was a wide band of hills and valleys, and this whole area was in magnificent old forest.

There are not many large animals inside such a forest, for most birds and mammals including deer and elk, black bears, and cougars are forest-edge oriented, like around rock outcrops, or the rich edges of rivers. You could sometimes stand in such a forest for an hour and not hear a bird, or walk for days and hear only a few birds. Most were high in the tree tops where there was light and therefore where most of the biological action occurred.

It was the robber baron's dream. The cutting gathered speed in the 20's and roared into the 1930's. It was get out the logs the fastest and cheapest way with few government restrictions and fewer government men to enforce the rules that did exist. In the onward rush, the tops and limbs of trees lay deep where they fell for more and more miles. It was a huge fire bomb with an explosion almost inevitable. It finally happened.

About 1938, a big fire incinerated much of the huge cutover. Four-years later there were more deer in that country than anyone could remember. The cutting continued into the 1950's, when most of the visible cutting was on the big hills next to the mountains. The old forest on the east slope was almost gone.

What had happened was a forestry disaster, a logging engineer's dream, and a logging company's bonanza. It was gross overcutting, and there would be a wood famine until it could be cut again, perhaps in half a century or more. But the deer loved it, and so did the blue grouse, and the cougars.

Through the early 1950's I was in the Sayward a number of times, as a biologist, and almost always was there with Don Robinson who was then game biologist for Vancouver Island. He was there much more often than I but at times we worked together.

My first view of the Sayward was in October 1951, a west coast day of cloud, mists, and long, heavy rains. We drove a confusion of old logging roads for miles, and I was impressed, and I suppose as a forester depressed as well. Quoting from my notes of the day:

> The burn is desolation itself, and all that I saw was old burn. It is an area of black logs, black stumps, bare slopes, and white rock faces washed clean by the rains. A few wet pockets of vegetation were not burned, but there are large areas now just stumps and bare soil.

Throughout this huge devastation there were patches of cover, willows and such in thickets by the streams, and patches of scrub timber, often on the hill tops.

On our second visit which was in February 1952, we met a very concerned game official who recommended the closure of deer hunting in the whole Sayward. He said there were too many hunters, too many roads, the country was too open, and too many deer were shot in the previous fall. "The place is shot out," he said.

We were puzzled. In our first small survey in October we had seen 52 deer in a day and a half (35/day). So we spent half a day among the stumps, and saw 20 deer (40/day). We also autopsied a fawn of the previous spring. It was a small thing, only 60 cm (about 2 feet) at the shoulder. It was thin, there was no fat in the body cavity, the lungs had ropes of lungworm, and the bone marrow was like jelly. The signs were those of over-population, a far cry from being shot out. We agreed to tie down the facts over the next year.

The picture that we verified was startling. The Sayward Forest was literally crawling with deer. In March 1952, we saw 179 deer in 1.5 days (72/day), and the following June, 271 in under 5 days (54/day). In February 1953, we counted 180 deer in 3 days (60/day). That survey included autopsies, as had others, all confirming medium to heavy loads of parasites and fair to poor physical condition of the animals.

Two months later, in April, we saw 164 deer in 2 days (82/day). Far from being shot out, the Sayward was overrun with deer with the usual results: small undernourished animals; unhealthy, diseased animals; and a tendency to die like flies in the spring if the winter has been severe. It was a classic case of over abundance causing a great deal of misery.

There were times when I was reminded of the game abundance of Africa. For example, 20 to 30 deer were seen retreating up a hill together and I heard of 13 cougars being killed on one hill in 5 days in about one square mile. Most impressive of all was when we left the carcasses of three deer only partly autopsied as nightfall closed in, and we resolved, to return at dawn to finish the job. My notes on the following morning's experience give the story:

> When we returned to the three carcasses over an hour after dawn to complete the autopsies, the air became filled with wings. Thirty-two bald eagles and about 90 ravens were at the carcasses. They roosted about the area in solitary trees and on stumps; some eagles were so engorged with food that they could not rise, but flapped running and hopping among the black stumps, or getting airborne they could not gain height, but laboured heavily away barely missing obstacles. The scene was reminiscent of a cloud of vultures rising from a carcass on the veldt. The three deer were thoroughly eaten. There was bone, and hide, and almost nothing else, a miraculously thorough job.

Blacktailed are small deer, but here I found how small they can be. Fawns rising to a year old could be only 40 to 50 lbs whole, or less, and this with a paunch full of food. Adult does were often under 65 lbs. Their size and abundance suggested big jackrabbits, and they had the knack of hiding effectively in open country like rabbits.

Here is an animal well suited to man-made habitats. As long as man harvests forests in these hills there will be deer in them. Populations will be scarce where there are heavy forests but abundant in the years following logging.

This story of the Sayward Forest, much condensed of course, illustrates a number of important points about wildlife. Guesses about what is happening to wild populations are usually wrong. It matters not how many deer come down the road on the fenders of cars in hunting season. You have to see what the population is doing through field inspection to predict change.

More generally, with little special effort, British Columbia should always have lots of deer, moose, rabbits, pheasants, blue grouse, quail, coyotes. Perhaps also black bears and mountain goats; just possibly also, with luck, a few remnant but safe populations of wolves, wolverine, cougars, sea otters, and so on. This will be possible because most of these need no special lands dedicated to their priority use. In other words, what man does to the land happens to supply the kinds of lands with the kinds of vegetation that such animals are happy with. A few others might survive fairly well because they prefer places that usually do not interest man. Some kinds of mountain goat country, most of it high in the sky and vertical, are examples. Similarly, sea otter's kelp beds on a remote and stormy coast, protected by dangerous rocks, could persist.

The right kinds of land do not guarantee successful wild populations. But add effective controls on people and the formula for success would be assured.

The Wild Wildlife

So much for easily accommodated wildlife. The other kind of wildlife is the kind that cannot survive when people change the land. These include all the living things that need clean, cold water, or for that matter, clean warm water. All those billions of lives that need old grasslands, whether on our prairies, Africa's veldt and savannah, South America's pampas, or the Asian steppes. It includes all those thousands upon thousands of species that must have old forests everywhere that forests grow or once grew; and all those lives that need clean oceans, or that cannot withstand the drain of man's high technology lifting ocean life by the ton out of the sea.

This process has gone on for centuries in places like Europe. Recently I had time to walk and think in some remoter places in western Scotland. It was March, and I felt quite at home; heavy cloud, mists hanging down high hills, lots of rain, and soft, cool air. It was west coast, like ours, only man had removed the forest centuries ago. Today's endless heathered hills, rolling on and on without a tree that would hide a sheep, had to be once covered in forest--thick forests of big trees--before man and sheep took over. Once, and not so long ago really, that coast was rain forest country like here. The proof is in the sizes of old trees planted on estates 100 years ago including some American species like Douglas-fir, and in those planted in the many new forests, the main species often Sitka Spruce reaching up two feet a year.

I wonder what wildlife roamed those Scottish jungles. No one is quite sure now. I also wonder what our islands will look like in a few hundred years. Maybe miles of heather covered hills, the landscape completely dominated by man's herds of sheep. The wild wildlife vanishes quickly with change.

The Toronto I grew up in was flanked by two rivers draining water and liquid garbage of various sorts into Lake Ontario. On the east was the Don; to the west the Humber, both named after British streams still lovely after 100's of years of man's domination. True to the North American way, the two Toronto streams were wrecked in less than half a century. Both almost ceased to flow in the summer after rampaging wildly inside and outside their banks in spring. And their beauty spots, near town at least, featured tires, bedsprings, and old cars.

I had most to do with the Humber, mainly because a large marsh still survived at its mouth, and still had interesting marsh birds, muskrats, and corners with plants rare in a land not rich in marshes.

Later in life I discovered an old book about the Humber, a sort of history of pioneers that was a great surprise, though I should have known. The Humber had, of course, once flowed strongly all year, cool and clean, through miles of virgin hardwood forests growing many species in rich, dark forest soil. Bears were there, white-tailed deer, snowshoe rabbits, beaver, otter, mink, marten, wolves, and there was even a record of cougar. Clouds of passenger pigeons wandered over the forests in search of good crops of tree seeds. Sometimes the great flocks took half a day to pass overhead. Ravens and Bald Eagles were there. I saw none of all those things, except for a few deer near the headwaters.

The greatest surprise of all in the book was that before man changed everything, the Humber was a famed salmon stream, but its fame was brief, for the coming of man in numbers soon caused the salmon to vanish. They were caught in nets blocking the river so none escaped to spawn; and speared by torchlight, a man spearing up to 200 a night. Salmon sold by the 200 lb barrel for 35 shillings. Two people in a canoe could fill 8 to 10 barrels in a night. Mills for grinding grain were water powered, as were sawmills, and each mill usually had a dam. About 100 years ago the rather short Humber River had 90 mills; so the river also had about 90 dams barring the way to spawning fish. Meanwhile land-clearing for agriculture destroyed the forest and with no forest, there was little flowing water - except when the river ran wild in spring at the snowmelt.

The Atlantic salmon were doomed four ways. If dams had not prevented reproduction, lack of water would have. If water had not failed, netting and spearing would have finished them. If all these had not made salmon impossible, today's sophisticated pollutions would have done the job. Its bad enough to be doomed once; but today four impassable barriers to survival is possibly a not uncommon condition.

The salmon vanished so quickly that many people who considered themselves pioneers on the Humber watershed never saw them; many therefore disbelieved stories about them being convinced that they never existed.

There are, of course, examples closer to home of wildlife unable to survive man's apparently inevitable changing of the land. One of them is our mountain caribou.

One of the most memorable sights I have seen for a long time was the 10 caribou I saw last August in high forest in the Selkirks. I was driving the Salmo-Creston Skyway, and there, in the pass, the caribou stood by the busy highway, in a highways maintenance yard among heaps of raw gravel. It was all highly symbolic. There stood perhaps half of the remnants of the southernmost population of caribou in our western mountains. For several reasons, probably, they will soon cease to be part of those southern Selkirks. The most evident reason for their dying out is that people are cutting down and carrying away the forests that must be there if the species we call caribou is to survive. 8,000 years after the retreat of the ice, the people invasion is wiping them out.

The caribou I once knew best were those in Wells Gray Park and areas east of it, about Murtle Lake with its old forest, and high on the alpine about and beyond Battle Mountain. It was there that in association with Ralph Ritcey, Ted Helset, and Bob Miller, among others we first began to see how mountain caribou survive in the wet-belt forests of eastern British Columbia. Through the 1950's we put a lot of energy into seeing not very many caribou, and we even put some flying time into the searches which was uncommon at that time. To make a long story short, we found that the local caribou were high and often above the trees in summer and winter, but in spring and fall the key to survival in times of soft snow seemed to be the old forest deep in the basin about Murtle Lake. There they could move and find food by pawing through the snow or by eating the beard-lichens from old trees.

Old forests in the valleys and up the slopes were a necessity in these mountains if there were to be caribou; and those same valley forests were the first that man removed as the country filled up with people. No wonder the mountain caribou were vanishing all over southern British Columbia. People were turning their valleys and valley slopes into places fit for fireweed and gophers, but useless to reindeer. The forest might return, but probably not the old forest, and certainly never the caribou, barring a miracle. After all it is theoretically possible!

It is a great and largely unknown truth that most wild animals lead hard lives on the edge of survival; that they can survive in only certain kinds of places; and that most individuals do not survive long enough to reproduce once. The few that do reproduce of course perpetuate the species. If a species is there--anywhere--but there, because a certain kind of forest is essential to survival, that same place is useless to the species if all it can offer is stumps and fireweed. The animals will die as soon as the essential kind of place is not there. End of species in that place. Repeat this often enough, and just as inevitably, end of species, everywhere. Extinction forever.

Those 10 caribou by the noisy highway, in the gravel yard, were the first caribou I have ever seen that were not exciting. They made me sad. They were so out of place, so vulnerable. And I drove on wondering how long the species will survive in our southern mountains. Twenty years, perhaps? Not likely.

The Proper Places

Just any land for wildlife is not enough. If land is to contain certain kinds of animals, it must offer the very specific needs of those animals. Obvious you say. And you are right. But the individual details are very exacting, and it is this that requires land meant to support wildlife to have very special characteristics, supplying very specific resources, in a completely reliable supply. Wrong kind of resources, or failure of supply, equals death.

Bighorn sheep land needs water, grass, and rugged escape terrain like steep slopes and cliffs. Sounds easy, but there is more to it than that. The water and grass have to be close enough to the escape terrain for the steep slopes to be really effective retreats from attacks. The grass sounds simple but it is not. To begin with it must be a reliable, constant supply. There must be enough to fuel the sheep all year round. There must be enough grass in the right places to feed the sheep through the worst storms, with the worst snow and ice conditions in all years. If there is not enough, perhaps a mile down the valley is another area of grass and slopes near water, and perhaps together the two areas can always offer survival to one band of sheep. Each alone would be an eventual death trap. The two together are the lands needed to save the sheep band.

Modern, urban people are, in one extremely important way, the most ignorant the world has ever produced. Most have no experience whatever in how to survive alone. Like babies, we are constantly cared for by other people.

For this reason we can hold wildly inaccurate fictions in our total misunderstandings of how wildlife lives, and of what wildlife must have if it is not to die. We are also completely oblivious to the facts of our own urban lives, and how--as animals--our general needs are really the same needs as those of a wolf, or a deer, or an eagle. Use your imagination with me for awhile. The year is 1700, and you stand alone on this rich, mild coast quite naked. You are a survivor from a small, local war, and you are alone. Your problem is survival, or in other words to find a place with accessible resources to keep you alive and healthy. Nothing else matters; everything else is much lower priority. All that matters is water, food, and warmth. You want to find these together, the closer together the better so you will not waste time and energy, nor unnecessarily expose yourself to enemies. Your only resources to begin with are your body, and stored in it are some food traditions, and some skills at stone age technology. With luck, you will make it; in most of cold Canada you robably would not. On this balmy coast crammed with wild edible plants and animals on land, in sea, and especially in the intertidal strip between, it would be bad luck to not survive, especially after the first bad week of seeking out the best human habitat available. First you might select a stick as weapon and digger and general purpose staff; then spend a few minutes to make a very sharp little stone knife; maybe then make a stone spear head for your stick, bound on by a fine root. Find some berries and edible roots, find the nearest clam bed and mussel rocks; make a rough shelter under a windfall, but search, as you explore, for a cave, your first clothes might be some thin sheets of bark, your first berry containers folded leaves. And so on. Months later, a simple log boat would enormously expand your mobility, hence enormously decrease the dangers of running out of essential supplies from natural resources near enough to be useful.

Like all animals, the needs of man--the needs, not the wants, not the addictive pleasures and comforts, not the desires to hoard things as wealth--the needs of man are simple enough when you list them. The rub once was in finding the few places on earth where variously mobile man could encounter these needs together to enable survival. The second rub was, of course, that only those places or combinations of places, having the needed resources year round, reliably, year after variable year, could sustain man indefinitely.

If intelligent green blobs from Mars had come here, and wanted to preserve man from extinction, they would have set up no shooting reserves, then declared parks and managed forests as incidental human preserves adequate to do the job. When such land became overused and degraded they would have purchased lands for humans. But most of the best human lands would, by then, have been either wrecked, or lived on by very defensive green blobs. As a result not many of the remnant lands available would be suitable for human survival year round, and fewer still would keep humans alive through the worst years of: hard winters, berry failures, poor fish runs, and so on. And then, the last resort would fail. The very few lands found that were really suitable would have the problem of many green blobs rolling around in them as tourists or scientists or engineers wondering what riches were tied up in the "lands for humans". And the humans would spend so much time avoiding green blobs that they would have no time to be successful humans, so they would just keep on going extinct, slower perhaps, but just as surely.

Today, you and I have the same needs as our naked friend standing on the beach in 1700. We get food, but in the food store; water, but from a tap; tools, but from a hardware; our clothes from a department store; our shelter from the local realtor.

The one huge difference is in the incredibly sophisticated technology working for us. But all this does is change the scale of what is happening. Today, collectively, we have incredibly effective methods for gathering up and carrying off the world's resources; and for using methods akin to magic, it seems, to find those resources when otherwise completely hidden from us. Also, this same technology has given us a mobility undreamed of by our friend paddling his first log boat along the shore. This new mobility, this world-wide net of transportation, now makes all resources all over the world available to everyone in the world. In a world still rich in resources, these mechanical and electronic capabilities to find, harvest, and transport the world's wealth, combine to make us probably the richest generations the world will ever see. Millions of people today live their lives not only with satisfied needs, but with incredibly overfed greeds.

There are two sides to this coin. One side has all this technology producing all this wealth, but what is really happening in terms of the real live world? Tune out all the impressive noise and confusion and we are only our naked friend, hugely magnified. Since our technology makes all the resource concentrations of the world findable, removable, and transportable anywhere in the world, in a very real sense, you and I live in a habitat that embraces the world. With the whole world supporting us, we can survive anywhere in the world. Its great while it lasts.

But the corollary, the inevitable other side of the coin, is that all of the world's resources are now under the need and greed pressures and demands of everyone all over the world. The result is Man blowing his inheritance on a global spree. And that spells trouble, deadly trouble, for wildlife everywhere, and eventually for man too it seems.

The next time you sit down to a table loaded with New Zealand lamb, California carrots, Idaho potatoes, Chilean wine, Israeli olives, rolls of Saskatchewan wheat, Brazilian coffee, Jamaican sugar, with English china, Nevada silver, Swedish glass for the Spanish port, and perhaps a good Havana cigar, think about our friend on the beach. To rephrase the original "You've come a long way, Mac". Perhaps too far? One fact is certain, no king in history had it so good! And this applies to food, drink other than water, shelter, general technology, mobility, entertainment, and to general good health and long life. You have lost in a few areas like water quality, air quality, and in having to trust hundreds of unseen people not to poison you, and otherwise kill you, for profit. And, you have also, of course, lost most of the world's wildness with its wildlife.

Not Just Land; Suitable Land

My purpose is to introduce our thinking and talking, about Land for Wildlife in British Columbia. I was to help set the stage, and that stage is a national and international one--a world stage.

Land for wildlife? From several viewpoints British Columbia never has had it. Often when we assumed we had it, time proved us wrong; and always we have really had it for people, not for wildlife, in spite of the labels we may have used. While I hope we will have real wildlife lands some day, I am from Missouri; you will have to show me.

When I came on the scene in this province there were a lot of game reserves. In those days, people thought that shooting was all that mattered, so you could not pursue or shoot at "game" in a game reserve. You could pave it over, that was legal. You could fill in the pond but you could not chase the ducks.

This province has many parks, often big parks. A few idealists used to assume that outdoor recreation and wildlife could flourish together; I was one of those hopeful people. Fewer believe this now. Parks are people places, and as the people pressure rises that philosophy is beginning to push wildlife out of parks, first the most endangered kinds, and many species remaining are changing from wildlife to tamelife. Parks are recreational, commercial. As land for recreation becomes needed as land for human survival, the wildlife will get even lower priority. In the cards for all large parks are heavy pressures from: mining, damming, commercial logging, commercial grazing, farming, private cottages, resorts, tourist towns, and traffic. Most parks seem to have assortments of these now.

The ecological reserve is so far our best concept. There are problems, however, in that most are too small for animals of some mobility, and the protective mechanism is largely a toothless paper tiger. There are paper legal decrees and paper maps, and there it almost ends--no real clout. Parks, I might add, are not much better protected, often for the same reasons.

A fairly recent development in the "land for wildlife" picture is the purchase of lands by wildlife agencies in government. An encouraging trend. But what happens, as in all the others, is not quite what the label implies. Like everywhere it seems, the influences of people such as noise, pollutions, and invasion are largely unpreventable. But more visibly, small 'p' politics takes over; people are not really excluded; a little grazing, farming, logging, camping, hiking, hunting, educating, and so on creeps in. First one, then others. The land, if you dig into both the practice and the concept, is not land for wildlife at all. It is really land for people; wildlife is a poor but desirable second priority. The result is a series of land use gambles on how people and wildlife can be mixed. Given that the people having most influence on land use policy always seem to know little about the needs of wildlife, guess who wins. The wildlife can vanish faster than if public attention had not been focused on it at all.

Land for wildlife? Surely you're kidding. Besides other difficulties, our cultural programming is against it. People are number one. People inherited the earth. People vote.

Through parts of this talk I have played the devil's advocate, but more than I want to I firmly believe most of it to be true. It is time to face the facts:

- People are everywhere. People populations are exploding.

- Even in British Columbia, people pressures on the land are in an accelerating increase.

- Politically, people's needs versus wildlife needs is no contest. When it comes to a showdown, most people choose people.

- Wildlife conservation needs land. Some wildlife, to survive, needs land without people.

- If these species are to survive for any appreciable time into the future, we need more imaginative thinking and planning and doing than we have ever done previously.

- Present conservation methods can be hugely effective at slowing the rates of wildlife retreat, and that is pure, priceless gain. It means that extra generations will glimpse the wonder of it all, and not only on old films.

- But is this enough? If we were so smart, high time to find a better way, or quit kidding ourselves.

- We know far more about the biology and ecology of saving wildlife than we will probably ever be able to use. To be sure, this does let us win some battles.

- But the war involves people, the people. This is what prevents us from establishing large, satisfying, effective blocks of land for wildlife. This people dimension we know almost nothing about. In a country like this it all seems to come down to votes. Nothing else seems to matter except what the people appear to want. And this, most of us must admit, is hard to beat as a political philosophy--except in relation to wildlife.

- Otherwise, the solution is simple: preserved land with the right preserved characteristics will preserve any wildlife suited to the characteristics.

- We need more clear recognition of our long-term problem, the people problem.

But we also have more immediate things to do, out there on the land where it counts most.

If in the year 2,000 we have still kept some badgers and rattlers and burrowing owls north of latitude 49°, we can be proud of our achievement in a worthwhile cause. And if we have kept some grizzlies, some caribou, some killer whales, and bald eagles south of latitude 52°, our performance will be worthy of many curtain calls. For there are a lot of people out there who want wildlife and who will pay for it. And what they want most is wildlife in their time. This we can arrange, for it is not yet too late--not in British Columbia anyway.

FAUNAL DIVERSITY AS A HABITAT GOAL

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Most of us here today read into the title of this symposium "Land for wildlife" the implicit assumption that it is appropriate to designate land to the primary purpose of maintaining the fauna and flora of our province. We accept the ethic of organic diversity as an axiom of land use policy, and would support the definition of this ethic provided by Wilson and Willis (1975) "that for an indefinite period of time man must add as little as possible to the rate of world-wide species extinction and where possible should lower it."

A year ago Bunnell and Williams (1980b), in a paper entitled "Threatened Species and Habitats - Why Bother" provided a thoughtful examination of the fundamental arguments for conservation of the biota. Among the ideas they presented we will all recognize the relevance of this quotation: "Species or communities that lack an economic value as natural resources are not easily protected in societies that have a strongly exploitive relationship with nature." Even the most idealistic among us cannot escape the observation that we in British Columbia are indeed a highly exploitive society. In the face of this how have we done in maintaining the natural faunal diversity.

As we examine this question we must also recognize that the great diversity of both flora and fauna in the province, along with the frequently very restricted distribution of some taxa, make the task of those entrusted with the wise management of lands a more formidable one than elsewhere in Canada. Although it will not be new to most of you it is useful to recapitulate some highlights of the richness represented by the biota of British Columbia.

Rowe (1972) described five forest types represented in the province out of the nation-wide total of eight types. Seventy percent of the bird species which breed in Canada do so in our province and of the 65 bird species which breed exclusively in one province, 54% occur only in B.C. There are 547 mammalian subspecies known in the Canadian fauna and 52% of them occur in B.C. Similarly 72% of the 227 subspecies that occur in but one province are confined to British Columbia. I suspect that the same situation occurs in the flora and in the invertebrate fauna (Bunnell and Williams, 1980a).

This biotic diversity is a direct reflection of the geomorphology and wide latitudinal extent of the province which, in turn, results in the extraordinary diversity of biogeoclimatic zones described by Krajina (1965) and of the 13 terrestrial biotic areas designated by Munro and Cowan (1947) to describe the distribution of birds and mammals in British Columbia. These I will use along with a review of changes in the numbers of individual taxa as a means of assessing how well we are doing in achieving the twin goals of maintaining the full diversity of our fauna while exploiting the natural resources for the economic benefit of all of us.

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[1] Paper was read by Dr. Bristol Foster.

In this review "land" will be taken as a short-hand reference to habitat. This I define as the total biological ensemble as well as the land itself. Habitat for a wildlife species includes all the co-occupants of the geographic area even though most of them, at any one time, are not known to be important to the well being of the species of special interest.

Organisms may influence others in the same community by being food organisms, predators, competitors, vectors for parasites or disease, essential modifiers such as hole-makers for hole-nesting birds, planters, selective retarders and modifiers of vegetative succession, warners of danger, and so on.

For the success of a species in any given unit of habitat absences, for example of predator or competitor, may be as important as presences. This is particularly cogent for island nesting marine birds.

Subspecies of vertebrates are frequently the reflection of the regionally specific changes in form and function revealed by many widely distributed species. The differences are assumed to be, and in a few instances known to be, a consequence of genetic change. There is no basis for the a priori assumption that subspecies are less important in terms of biological diversity than are species. The Columbian black-tailed deer (*Odocoileus hemionus columbianus*) is as important in its ecotype as is the mule deer (*Odocoileus hemionus hemionus*) in its, and no less important than the white-tailed deer (*Odocoileus virginianus*). The California bighorn and Rocky Mountain bighorn, Stone sheep and Dall sheep, Roosevelt elk, and Rocky Mountain elk are in each instance examples of subspecies pairs readily recognizable by the informed individual and adapted to the life circumstances of different habitats in which their survival is our responsibility. The navigator shrew (*Sorex palustris navigator*) and the Vancouver Island water shrew (*Sorex palustris brooksi*) are distinct subspecies pairs of similar biological meaning and equally demanding of our concern.

Munro and Low (1980) announced a provincial policy for rare and endangered species that neglected subspecies, except those that have a high public profile. It proposed also to ignore peripheral species that were believed to be common elsewhere in North America. This very restricted policy found no supporters among the other participants in the conference on "Threatened and Endangered Species and Habitats in

British Columbia and the Yukon", but there has been no announcement of a redefinition of policy by the provincial government.

A large proportion of the species and subspecies that, in Canada, are unique to British Columbia could be regarded as peripheral taxa. Such populations can be extremely important to the survival of a taxon. As an example the California bighorn, which formerly ranged from central eastern California to southern British Columbia, was extirpated throughout its range in the United States. The peripheral population in British Columbia became the only source of stock for reintroductions to its former range. Similarly, after the devastating winters of the late 1880's, the elk survived in western Canada in three small peripheral areas separated by hundreds of miles. These relict stocks have been largely responsible for recolonizing the former range of the species.

Rather than ignoring peripheral taxa and populations, a general policy should be to acknowledge many of them as important sources of genetic adaptation and valued elements in the faunal diversity for which British Columbia has a responsibility to Canada and to other political areas in which the taxon exists. This policy would increase the problems to be mastered in achieving effective conservation. Anything less is a disservice to the community. Maintaining the full diversity of our fauna is the inescapable responsibility of our Fish and Wildlife Branch. Defining the task in other terms is unacceptable.

Faunal Changes: 1930 to 1980

Most vertebrates experience fluctuations in numbers over time that are unrelated to known human activity. It is therefore difficult to determine changes that should elicit management response. Furthermore, data on the numerical status of most species do not exist, or are highly subjective. British Columbia alone among the western provinces maintains an annual survey of the approximate numbers of wildlife taken by hunters. For 28 years, B.C. has used a statistically validated system of samples drawn from license holders. The sample can be depended on within its designated limits but there is still the question as to the relationship between the numbers of a species taken and the animal population in the field. Similar statistics on the annual take of fur bearing mammals by trappers are maintained by Statistics Canada.

For nearly thirty years, there has been an organized attempt to obtain each year a direct count of waterfowl breeding in western Canada, though this effort has been largely concentrated in the prairie provinces and in adjacent Northwest Territories. The result has been a useful body of data concerning geese and freshwater-nesting ducks.

Since 1967 the Canadian Wildlife Service has undertaken a breeding bird survey (Erskine 1978). Unfortunately, there has been little consistent effort in western Canada. Thus, the part of Canada with the greatest variety of species and habitats is largely unrepresented. The Canadian Wildlife Service in British Columbia could make a significant contribution to the wildlife data base by establishing and continuing standardized breeding bird surveys on avian habitats selected for their vulnerability to change for ten or twelve years.

There has been no attempt to follow changes in the numbers or distribution of the small mammals.

The number of people involved in the serious study of the birds, mammals, reptiles, and amphibians of western Canada is small and has had few resources of time and money to devote to monitoring population changes. Therefore, priorities for attention have been allotted to the game species and to the few other species which have been suggested by informed naturalists as declining to the point of endangerment. The importance of the amateur naturalist in detecting species or subspecies in serious decline and in influencing policy toward better management cannot be overemphasized. Collectively, they probably do more to monitor bird and some mammal populations than the professionals and through their central organizations, the B.C. Federation of Naturalists and the B.C. Wildlife Federation, exert pressure for conservation.

Using the data arising from the above sources, along with the subjective judgement of knowledgeable naturalists and professional biologists, it is possible to list changes in numbers or distribution of wildlife in the province over the past 30± years. These changes can be examined for those where habitat deficiency appears to be responsible for the altered status.

Because most of the large ungulates are not confined to one or two biotic areas, and endure the additional hazard of a hunting kill, they will be reviewed as a group rather than within the biotic area analysis. The Columbian sharp-tailed grouse similarly requires grass plains in several biomes and is treated in general terms.

For the majority of the vertebrate fauna I have reviewed each of the 12 biotic areas for each species or subspecies to determine what taxa we have gained or lost and what numerical changes we know to have taken place that are probably a result of man-induced changes in land (habitat). Admittedly a lot of judgement is involved, but when substantive data are absent, the impressions of experienced observers are the best sources available.

Large Ungulates of Wide Distribution

In the mountainous terrain of British Columbia many stocks of the ungulate mammals depend for their survival on winter ranges offering low snow cover, unusually nutritious vegetation, the adjacence of escape terrain or other special qualities. It is common experience that many of these essential winter ranges are also attractive for agricultural use as crop land or for domestic livestock grazing. This has led the Fish and Wildlife Branch to attempt to secure title to key winter ranges so that they can be managed with wildlife as first priority. The principle is an important one as adequate winter range is the limiting factor when other aspects of management are adequate.

Cowan (1980) reviewed the data on wildlife harvests in British Columbia and made the assumption that these data reflected the populations from which the kills were taken. In deer, elk, and mountain goat the kill increased as the number of licensed hunters increased until 1960-64 and then declined. Bighorn sheep and moose yielded their largest kill in the 1965-69 quinquennium and then decreased. The declines are continuing. For these species a decline in catch-per-unit-effort points strongly to overkill as the cause of the decline. Steadily increasing access provided the opportunity for this overkill to occur for several years before the problem was identified and new management initiatives attempted.

Thus, while land is of ultimate value in the maintenance of populations of wild ungulates, it does not substitute for effective management of the kill. This was missing in the period up to 1978.

The province-wide statistics obscure local differences within a species. Thus, caribou of the Selkirk Range appear to be threatened with extinction as a result of inadequacy of lichen-forest stands in its winter range. The same species in the Stikine area is declining, probably from the combined impact of hunting and predation. The caribou is the most seriously depleted large ungulate in B.C. The Queen Charlotte Island caribou has been extinct for at least 40 years but the role of habitat change in the extinction is now known. The introduction of the black-tailed deer to its habitat may have been a factor.

New management principles now being implemented suggest that some of the lessons from the past have been learned and some stocks may be restored. If this occurs there will be need of much more carefully selected land dedicated to wildlife use.

The usual beneficiaries of winter range acquisition are bighorn, elk, and mule and white-tail deer. Goat, moose, and caribou demand a different approach.

The greatest urgency for winter range lands at this time is almost confined to the southern valleys of the province. This continues as a major priority. However, in the northern part of the province potential damming of the Liard River for hydroelectric purposes may result in the loss of important winter range for elk.

Galliforme Birds

The sharp-tailed grouse is the only seriously depleted gallinaceous bird in British Columbia. Formerly widespread in the interior grasslands and adjacent sage (Artemisia) areas, it is now almost eliminated in southern areas west of the Rocky Mountains. Determination of the role of habitat in this situation should be assigned to a task force including game-bird biologists, rangeland ecologists, and range managers drawn from the government agencies and the universities.

The other grouse inhabiting the province appear to be maintaining their numbers under simple management procedures.

Anseriformes

At the time of writing I have been unable to obtain data on species-specific changes in the anseriformes of the province over the past 30 years. The work of Leach (1979) has documented the declines of almost all species in the Fraser River estuary and delta. Similar declines have occurred in most of the other estuaries but they are not so well documented because the areas and populations are smaller. I suspect that the indigenous resident race of Canada Goose, *Branta canadensis fulva* has declined sharply--probably through overkill on its confined winter areas and habitat change elsewhere.

Without doubt the acquisition of key estuarine areas is a top priority for preservation of anseriformes, but acquisition necessitates management. Neither the provincial or federal wildlife authorities appear to have the staff or expertise to discharge this responsibility.

The excellent habitat development for waterfowl at Creston, the Pitt Poulder, other small wetland areas on the Fraser estuary dedicated to wetland wildlife, and several land areas bought by the National Second Century Fund of British Columbia, are valuable additions to wildlife land for waterfowl and other wetland species. In addition the habitat improvement work of Ducks Unlimited must be acknowledged as a contributor to maintaining the diversity of freshwater wetland wildlife in B.C. The changes in nesting populations of this fauna in the Caribou parklands and Peace River parklands has not been documented though there are good base data available from the 1940's.

Nongame Birds and Smaller Mammals

Data on the avifauna, smaller mammals, and herpetiles of the 10 terrestrial biotic areas is meagre, spotty, and lacks consistency. Thus, only broad generalizations can be made.

The Northern and Southern Alplands, Boreal Forest, and Subalpine Forest Biotic areas yield no significant habitat-related changes in fauna other than those already alluded to under big game.

The biotic area which has suffered the greatest habitat changes is the Coast Forest. It is interesting that there are few documented alterations in the avifauna directly traceable to these changes. Several species of birds have extended their ranges from the south, so there have been net additions.

I suspect that the Lewis woodpecker, once very abundant and now almost gone, has fallen victim to the snag-falling dedication of the foresters. Indeed the hole nesting species in general have declined. The spotted owl is now close to expiration.

The Vancouver Island weasel (*Mustela erminea auguinae*) and Brooks' water shrew (*Sorex palustris brooksi*), unique genotypes evolved over thousands of years, are extremely scarce and the shrew, at least, endangered. Our knowledge of them stems totally from the examination of 4 specimens of the shrew and perhaps 20 of the weasel. Our ignorance of their habitat requirements and biology is total and there seems to be no official concern over this situation.

The Queen Charlotte Islands Biotic Area has experienced devastation of its Sitka Spruce old growth forests. As well, there have been introductions of beaver, red squirrel, European rats of two species, racoon, black-tailed deer, and American elk. All of these have established themselves. There are no data on the impacts of deforestation or the exotics upon the status of several unique taxa of mammals and birds.

The Queen Charlotte Island weasel (*Mustela erminea haidarum*); marten (*Martes americana nesophila*); sitka mouse (*Peromyscus sitkensis prevostensis*); Queen Charlotte Pine Grosbeak (*Pinicola enucleator carlottae*); Queen Charlotte Saw-whet owl (*Cryptoglaux acadica brooksi*); and hairy woodpecker (*Dendrocopus villosus picoideus*) among the terrestrial vertebrates are all "national treasures", probably prepleistocene in origin. Most of them are believed to survive in viable numbers but their status and distribution are not documented. The weasel may well be an endangered taxon.

I urge a concentrated effort spearheaded by the Provincial Museum to determine the status and trends in numbers of these taxa and to determine what their habitat requirements are. The goal should be to identify, acquire when needed, and manage areas of land appropriate in size and habitat to make sure that we do not lose these unique forms of highly adapted animal life.

The Osoyoos Arid Biotic Area presents one of the saddest conservation stories in Canada. It has taken 17 years of effort by dedicated naturalists and professional wildlife biologists to encourage the government of British Columbia to set aside a pathetic pocket-handkerchief-sized few hectares of the local vegetation. This will have no impact at all on the survival of the unique biota, the Nuttall's poorwill, white-tailed jack rabbit, sage thrasher, Brewers sparrow, burrowing owl, pallid bat, pinto bat, and others that are suffering the neglect which derives from the present policy of the Ministry of Environment. I believe that there are survivors of some of these species and that it is not too late to designate some land toward maintaining a "specimen" of this fauna. This biotic area is the number one target for the definition and acquisition of *land for wildlife*.

The Dry Forest fauna has suffered fewer changes. Perhaps the badger (Taxidea taxus) is the most dramatically altered in status, having gone from abundant to endangered in about 40 years. The bobcat (Lynx fasciatus) has also declined. It is doubtful that either can be increased in numbers by creating dedicated areas of wildlife land. They urgently require the institution and enforcement of a management regime designed to foster their recovery.

One cannot refer to this biotic area without acknowledging the accomplishments of two groups of very dedicated citizens: The Okanagan Similkameen Parks Society and the North Okanagan Naturalists Club. What has been achieved has been largely through their dedication and determination. Again, at the eastern edge of this region in the Rocky Mountain Trench the dedication, enthusiasm, and courage of a small group of largely Fish and Wildlife staff has put this region ahead of all others in its land acquisition and land management.

In the Caribou and Peace River Parklands agriculture, initiation of hydro-power production, and now recreational land development threatens some populations of wetland fauna. But no recent studies to parallel those of J.A. Munro in the 1930's and 40's are being done and the changes are not known and cannot be responded to.

Certain waterfowl such as white-winged scoter, ring-necked duck, and white pelican have very restricted breeding sites in B.C., sometimes just one or two special lakes. Steps have been taken to stem the reduction of pelican numbers, but I find no data as to the continued survival of the other two species as nesting avifauna.

The wetland fauna of these two parkland areas responds well to tested land and water management practices. This is a fauna clearly within the responsibility of the Canadian Wildlife Service. It should be monitoring populations and identifying special habitat areas for acquisition and special management.

Two other biotic areas, Gulf Islands and Columbia Forest, appear to have retained their original faunal diversity despite major habitat changes. The status of some of the small mammals in the Puget Sound Lowlands is unknown but apparently greatly reduced. Aplodontia appears to be in this category. Here also the white-fronted goose (Anser albifrons) and the nesting population of the sandhill crane (Grus canadensis) are reduced to a small fraction of original numbers. The latter has almost reached extirpation.

Land Dedication to Wildlife

The list of land designations dedicated in a primary or secondary way to the fauna of B.C. is a lengthy one but is not detailed here. It includes national and provincial parks, migratory bird sanctuaries, national wildlife areas, wildlife management areas, and ecological reserves.

In British Columbia 94.44% of the land is provincially owned so the complication of private ownership does not inhibit the effective inclusion of wildlife in land use plans over the majority of the province. Unfortunately, the potential has been very slow in realization.

One of the most important new developments has been the appearance, over the last few years, of organizations dedicated to the acquisition of land for wildlife conservation. Some areas of great importance to wildlife have been transferred to private ownership over the years. The National Second Century Fund for British Columbia, Nature Conservancy, private donors, and, more recently, the Provincial Habitat Conservation Fund exist to recover this land for wildlife use. Ducks Unlimited has been an active and effective co-operator where wetlands are concerned.

Conclusions

This review suggests that British Columbia still has at least 99% of the original natural diversity of vertebrates. This is interesting and even surprising in view of the massive habitat changes that have accompanied "development" of the province. Despite this general situation a few species and several subspecies are greatly reduced in numbers. Some are regarded as endangered. Many of these very scarce vertebrates are being officially ignored on the basis of a narrow and confining definition adopted as policy by the Fish and Wildlife administration. This should be corrected so that the task of managing for the survival of all species and subspecies can be defined and proceeded with.

Some priorities for the designation and management of land as wildlife habitat clearly emerges. Further inquiry is needed to identify the potential for designated habitat to preserve the diversity of our vertebrate fauna as well as to contribute to the maintenance of some species for consumptive use. For some rare and vanishing species control of their habitat is essential. For most taxa, however, the setting aside of areas large enough to accommodate viable populations is impractical. The need rather is to manage the other activities on the vast public land areas with a concern for the well-being of vertebrate species dependent upon it.

Priority for land acquisition for wildlife habitat appears to be most urgent in the southern Okanagan and Similkameen valleys; in the Dry Forest grasslands and shrublands, and in the estuarine areas along the coast. Some waterfowl areas in the Peace River and Cariboo Parklands, threatened with drainage, alteration by agriculture, or "cottage development", are also candidates for acquisition.

One of the most important recent events is the availability of financial resources and support to acquire key areas of wildlife habitat that are in private or corporate ownership. The lands for wildlife are increasing each year. There is now an urgent need for the provincial Ministries of Environment, and Lands, Parks and Housing to equip themselves to meet the new responsibilities to manage wildlife lands.

There is improving liaison between citizen organizations and the government offices sharing a concern for the provincial fauna. This should be expanded. It is urgent that all those interested in the maintenance of the biological riches of British Columbia coordinate their efforts and focus on major issues. The monitoring studies are not being done and management is inadequate in the face of a steadily enlarging population and a very rapid encroachment of "development" into areas once protected by their remoteness.

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SOME PAST HISTORY, CURRENT PRACTICES, AND FUTURE NEEDS FOR WILDLIFE HABITAT MANAGEMENT

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The past history of wildlife habitat in British Columbia is in large part a recording of the life styles and needs of early explorers and pioneers from other lands. Because of ignorance about single-purpose development and low human densities, not many species of wildlife had their habitats affected significantly by man. In short, by today's standards in southern Canada, the early resource exploiters were not very efficient at farming, logging, mining, or building towns. This inefficiency left uncleared places on farms and in forests, vacant lots and wild areas in cities, and generally left a variety of habitats even close to towns and cities. Further expansion of rural British Columbia came after World War I but the population was still scattered widely and even cities were not densely settled. Human population was small.

During the 1920s and 1930s there was a retreat of settlement as settlers went broke. Many lands reverted to disuse and became more forested once again as early forest succession began. These same two decades, however, brought an increase of people who saw southwestern British Columbia as armed forces personnel, as factory and dockyard workers, as airport and highway builders, and as service industries to this population. The following population of B.C.* figures are pertinent:

	doubled			doubled			
1911	1921	1931	1941	1951	1961	1971	1981
392,480$^{33.6}$	524,582$^{32.6}$	694,263$^{17.8}$	817,861$^{42.5}$	1,165,210$^{38.8}$	1,629,082$^{34.1}$	2,184,621$^{23.7}$	2,701,900

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*Corpus Almanac of Canada

You will note the period between 1931 and 1941 does not show a large increase but remember that our population had a lot of transients who had registered homes elsewhere. They would come back.

World War II and the immediate post-war years brought us our largest percentage population increase. It also brought new technologies developed during wartime and the seeds of the massive technological changes to come. Computers, electronics, tremendously larger internal combustion engines, plus higher employment and higher wages began to put a strain on our pioneer way of life. Economies of scale had drastic affects on the life styles of people in farming and the lumber industry as the heavy investment in mechanization had to be reckoned with.

Minimum economic herd size for beef jumped from around 70 head to 150 head. Dairy herds increased from 20 or 30 animals or less, to 70 or 100 or more. The chainsaw changed the woods part of the lumber industry as did huge trucks, cranes, and caterpillars. Cut blocks increased in size. The ability of man to change the environment was in full swing.

By the mid-1950s progress had not treated all Canadians equally. The little farmer, the little logger, the little sawmill and truck logger, the small rancher and dairy operator were all in trouble. Statistics now showed them to be underemployed and their self-employed wages were often at or below the Canadian poverty line. This was a new kind of poor--one that had not previously been on the welfare roles. At the Resources for Tomorrow Conference politicians, scientists, ranchers, loggers and many others were brought together in a problem-solving, nonpolitical forum. As an outgrowth of this conference and the Senate Committee Report on Land Use, several new programs were launched to cope with the problems identified. One of these was the Agriculture Rehabilitation and Development Administration (ARDA). The intent, generally, was to strengthen farm units by increasing size and finding alternate employment for those farmers who needed extra income while remaining on their little holdings; or who needed new employment when they sold their holdings for the consolidation to larger farms. The thrust of alternate employment was toward resource-based industries. Funds were made available to buy farms, retrain, and provide start up money to new industry. The Canada Land Inventory was established so that the mistakes of the past would not be repeated. The governments did not wish to take good farmland out of production, they wished to take poor farmland out of production and where possible turn it over to more productive resource uses. Similarly, government did not wish to encourage a recreational or a forest enterprise or whatever, without being reasonably certain that the land was suitable for that use.

The Canada Land Inventory was a large program and a truly cooperative one between federal and provincial governments. Core standards for each type of inventory were negotiated by consensus.

The CLI included following inventories:

1. Soil Capability for Agriculture
2. Soil Capability for Forestry
3. Land Suitability for Recreation
4. Land Suitability for Ungulates
5. Land Suitability for Waterfowl
6. Present Land Use

In British Columbia only, we also had:

7. Climate Inventory
8. Socioeconomic Assessments.

The result for most of the province was coverage on a nearly comparable basis for the main renewable natural resource sectors. Canada Land Inventory information was the building block for the first regional resource plans in British Columbia and resulted in the publication of the Land Capability Analysis series.

I would like to diverge a moment to point out that the CLI occurred everywhere and was successful everywhere. It was more successful for planning and conflict resolution in British Columbia because the politicians were behind it and because the bureaucracy from the deputy ministers down were behind it. The program was explained carefully at all levels and was set up to be administratively and scientifically responsive to government and public needs. The late Dr. Alex Turner, then Deputy Minister of Agriculture, was the inspiration behind both the responsiveness and acceptance. This was no easy task and its importance cannot be overlooked. The Canada Land Inventory was and is the largest comprehensive coverage of renewable resources on a comparable basis in the province. From a wildlife habitat standpoint, the Canada Land Inventory was important because for wild ungulates it designated the location of wintering areas and showed their importance relative to the surrounding terrain. For waterfowl also the habitat areas used for nesting and rearing were shown as well as those for staging. But make no mistake. There were things wrong with the wildlife inventories and I will go into some of them later. What is important is that the CLI encouraged constructive criticism and that criticism has improved our understanding and will help the way ahead.

ARDA itself did not affect B.C. habitat or wildlife very much in its early days. It did fund the Maxan Lake Project which dealt with the habitat of wild and domestic ungulates. This project also provided the theses of two of the province's leading wildlife biologists and gives us a wealth of information on vegetative succession in that biogeoclimatic zone and subzone and the plant communities represented. Later ARDA and its subsidiary agreements provided Coordinated Range Resource Management Plans and these have been a distinct advantage to wildlife and wildlife habitat. Domestic grazing has been improved such that less deterioration of range occurred, water areas have been partially fenced and some areas reseeded. In the East Kootenay, agriculture and wildlife have worked together and should work together more closely, to prevent encroachment of low-productivity forest species on big game winter range. Certainly there have been some wildlife grumblings about ARDSA and ARDA. But in British Columbia the benefits to wildlife have far outweighed the losses. Some biologists are prone to saying that agriculture and wildlife are incompatible. What they really mean is that intensive agriculture and wild ungulates are almost always incompatible. One can seldom deal in such generalities when discussing land uses and wildlife habitat. Often a land use change will result in the loss of some species and the gain of others. In fact, wildlife habitat management is the process of using or treating land in such a way that it benefits target species.

Currently, land development activities are affecting land and habitat in every region of the province. Urban areas are increasing and will increase in the future. Industry will continue to grow. Mining will not diminish generally and coal mining will certainly increase. Forestry is becoming more intensive and trees harvested in the future will be younger than in the past. In the longer term, let us face the fact that British Columbia is to Canada what California was to the United States. People will continue to move to British Columbia as a place of resource and recreational plenty. Accompanying this movement there will be increased manufacturing and industry of all kinds. We may not like it but we cannot stop the process. We must learn to live with this reality and plan for it. It seems hard to accept this in the middle of a recession, particularly if you are from the forest industry and have just been laid off. But accept it we must.

If we are to succeed in maintaining appropriate habitat for wildlife we must also succeed in maintaining appropriate habitat for man. The idea of habitat for man must encompass the whole habitat including sociological, psychological, and economic dimensions and there must be a recognition that man needs animals and plants for sociological and psychological wholeness. They are needed also for economic reasons, not the least of which is that they are highly sensitive environmental indicators of problems which can affect man.

We will have to change many attitudes and current practices if we are to cope better in future. Most habitat is presently controlled for large game animals and burning is the major tool. But even here we have been insensitive. There has been little systematic documentation of the key factors likely to control response. Thus the same burning methods have been used with little attention to the differences in soil, in soil moisture, or to the stage of plant succession that the desired species-mix occupies on the way to different climaxes. The results have sometimes been wasteful. The Canada Land Inventory maps are not good enough for determining the sites where intensive management for big game should occur. They only tell the areas in general. In some cases the Class I wintering area is not the critical habitat; instead it is adjacent Class 2 or Class 3 areas that are most important.

Wintering areas for deer on northern Vancouver Island and other areas of occasional very heavy snow accumulation are not always the areas shown on CLI maps since the dependence of deer on mature timber stands was improperly understood at the time of mapping. Even now we have not made best use of existing situations to predict the age at which second growth becomes sufficiently usable for deer in a bad weather. We also do not know how extensive a mature stand must be to serve the population of a particular watershed. CLI maps do not map nongame species or fur bearers at all.

Much emphasis is often given to the need for numbers of animals and the value of an animal so that unbiased, economic benefit/cost analyses can be used to determine what can be allowed for forests or other resource uses and what for wildlife. Many animals cannot presently be counted with any accuracy. We should remember that the economic yardsticks are societally derived and that our society determined that we would not sell wild animals. The marketplace has been decreed not to exist in the traditional sense. Why then, should wildlifers try so hard to justify their actions in economic terms? Forestry is an admittedly economic operation and will always be the biggest single influence on wildlife habitat. Perhaps we should spend more time looking at their operations to determine how economically justified they are. A few examples should suffice:

1. How does forestry determine where intensive forestry should occur? Should intensive forestry be applied to low productivity areas as is sometimes the case?
2. By what economic criteria does forestry insist that over-mature stands, including snags must be logged? The insect arguments are not correct or cannot be proved. These stands are good habitat for a number of wildlife species that are solely dependent on them. Yet there seems to be little rationale for this traditional forestry practice which is often a hardship on the companies as well.
3. Why are better roads and logging practices to reduce erosion, slumps, and siltation considered environmental costs when lack of these practices delays a future harvest because of slow regeneration?

Having asked these questions, I would point out that presently the dynamism for improving knowledge and operational plans for wildlife habitat resides largely in the Ministry of Forests. A habitat manual is required describing habitats, their dynamics, and manageability is required in B.C. The Research Branch of the Ministry of Forests, the Fish and Wildlife Branch, and my own Terrestrial Studies Branch as lead agency are beginning this important work.

The developmental effects of mining are handled by the B.C. Metal Mines Guidelines or the Coal Guidelines and these procedures seem competent to handle environmental assessments as well. However, reclamation is another thing. There is a need to establish habitat guidelines for mine reclamation. Foremost in this issue is that native plant species be used for maximum benefit. We cannot require this from the companies, however, until we are able to tell them what species to use and where they can obtain the planting stock. Another problem relating to mines or petroleum resources is exploration. We still do not have a good way to handle environmental impacts, including habitat changer, of exploration activities and this is needed even though the mining community has greatly improved its attitude and practices.

Salmon enchancement has really just begun and yet we have not prepared for the loss of estuarine waterfowl and shorebird habitat which will be induced by some projects. Attitudinally, we are not prepared to examine the impacts of intensive developments in segments of our natural heritage such as fish and parks. Similarly, we are not prepared for the coming necessity of intensive habitat development for intensive wildlife management. Wilderness in the sense that my generation knew it, is dead and we must keep up with the new demands so that relative wilderness will be there for tomorrow.

These are only a few of the areas where we will have to change our current views of habitat. They are in response to fairly immediate or current happenings. Natural, in the sense of untouched, will be less and less possible in southern Canada and we will have to modify, enhance, and develop habitat to maintain suitable wildlife populations. More long-range changes must also be faced. Small power developments in small streams and rivers, some with dams and some without, will have to be reckoned with as energy prices increase. Petroleum exploration onshore and offshore will increase. Will coal and wood also increase in usage? What are the implications if they do? What are the implications to human population growth with a swing to natural gas consumption?

The future holds complex problems which require complex teams of scientists and public input for solution. No longer will wildlifers be able to keep habitat to themselves; they are going to need plant ecologists, soil scientists, climatologists, hydrologists, and others to assist in the management effort. Above all the rest of society must be behind them.

I could go on and discuss the implications of satellites, even faster communication and fibre optic technology and other potential developments for wildlife habitat management. But I will close with a parable of the land as I interpret it due to time constraints.

PARABLE OF THE LAND

The land does not care about mankind. The land has made millions of experiments with different life forms and all have gone their way. Some stayed on the land for a very long time, and then were snuffed out. There was no crying on earth--not by the land--not by the other creatures. There was no crying for the loss of the earlier unicellular forms. There was no crying for the death of the dinosaurs.

The dinosaurs were on earth for a relatively long time. Man has been present to date, an instant in the time of the earth. There will be no crying for man. There will only be a new experiment with an old life form or with a new one. The earth does not care. Man may so increase carbon dioxide that an old life form may be his best successor. A successor from the heavy-moistured past. The earth has never cared. Man is unimportant. Man is nothing, no more than the cicada, the sequoia, the pygmy shrew, or the wooly mammoth. Man is only important to man. Man says he is important to earth.

The earth is important to man. Man will continue on this earth only so long as he, in great selfishness, realizes the importance of the earth, the land, and all that it nurtures. It is only from great selfishness that he will husband all of the land and all of its creatures. He on earth is the only thing than can benefit, prosper, and care. Care not for the creature, but for himself, and because of himself, for the creature and for the whole land-creature system which is the earth.

Man is a vintner making wine with grapes and water. He should know that many different kinds of yeasts and many different kinds of grapes make many different kinds of wine and many different kinds of vinegar. He should know that he makes his product for himself and not for the yeasts, the grapes, the soil that grew them, the air that bathed them, or the sun that shone on them. They do not care. No more does he make his product for the insects that fed on the vines, the birds that fed on the insects, the mice or the snakes or the water or the foxes or the rabbits. They do not care. Only he cares and he cares for himself.

If he cares for himself and his progeny in full knowledge of his importance, perhaps he will survive, for this is true selfishness, the selfishness of mankind. If he cares only for immediacy as an individual, he will surely perish as a species. There is no selfishness for mankind if a single man burns down the forest in hopes of getting roast venison. Such an act or series of them, may even limit the satisfaction of a particular man's selfishness so that it covers less than his possible lifespan. We have the knowledge of fire and do not use it so stupidly. Yet we have knowledge of many things about the land and use the knowledge stupidly or ignore it for someone's short-term gain.

Thus it is that we stand by and let a developer subdivide and build houses on a flood plain. Thus it is that we buy the houses. Then comes the flood or the landslide that we could have avoided, and the tears and the anguish. Then comes disaster payment from our institutions to help the people. The land is called disaster. Surely in our selfishness we can save the land for the frogs and for recreation and for farming and let the developer build our homes in places less harmful to the land, the families, and ourselves because we will benefit from an unharmed land and from comfortable homes. And we will not lose because the frogs are there, or because people can play and crops can flourish between floods.

There are no economics, and no decisions are truly made on an economic basis. There is only life and death. There is only food and starvation. There is only shelter or exposure. Mankind has many soothsayers who are economists but they are soothsayers of the outcome of self-devised games. The earth does not care about cost-benefit or benefit-cost projections. The earth does not care about external or internal markets. The earth does not care about political boundaries. Neither do the trees or birds nor any living thing care about lot lines or cadastral surveys. The earth does not care whether the "ownership" of man is public or private. The earth does not care whether we are fully employed. All of these are games made by people.

Man has changed the face of the land in many parts of the earth. He has grown wheat and corn in immense acreages where once native grasses grew. He has planted new tree species more suited to his purpose than the original forest. These are not in themselves bad things because his new crops take the same place in the ecosystem that the native plants took and that is a good thing.

Man can fight with man over economic games devised by man. Man can fight with man over profits, ideologies, politics, or morals. While he is fighting over these man-made games, the earth will inexorably take its toll. The toll is a new environment and new species or new species composition.

The earth does not care. Does man care?

STRATEGIC PLANNING FOR WILDLIFE IN BRITISH COLUMBIA

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One of the first problems that anyone entering the planning field experiences in this province is that most organizations, both public and private, exhibit a decided bias against planning. Those of us who are planners by persuasion rather than by training are probably more sensitive to the bias because we have experienced the problem from both sides. Management is active, decisive, and macho. Planning is contemplative, cerebral, effete. Some people even discriminate between different levels of planning. Operational planning is acceptable because it leads to a short-term payoff in tangible actions. Longer-term policy planning is less acceptable because the payoff is not immediate and there are real difficulties in measuring benefits. Perhaps the two most common reasons for not wanting to plan are, first, that we can not afford it, and second, that situations are changing so fast that rational planning is impossible. In answer to the first I would reply that in times of increasing constraint, any organization--whether private or public--needs to control the assignment of its staff and monetary resources. It needs clearly established objectives and organized, continuous, and disciplined effort towards achieving those objectives; that is planning. In response to the second excuse related to increasing change and uncertainty, I would say that we must not confuse forecasting and planning. To forecast is to predict the future. Planning, while it uses forecasts to establish direction, should enable better preparation for the future, whatever it may bring. The more rigorous and flexible the planning process, the better are the chances of surviving bad forecasts. In any case, it is surely more efficient to deal with change and uncertainty by revising from an established base, rather than constantly improvising from scratch.

I believe that there are two more fundamental reasons for the antiplanning bias. First, despite some protestations to the contrary, many people still cling to the frontier mentality in the belief that we live in a land of near limitless resources. In other words, if there is enough for everyone, why bother planning. Second, and a more serious problem, I believe that society has lost its sense of the future. Our time horizons are constantly shortening. We tend to focus on the short run and ignore the longer-range implications of public and private decisions. The consequence of this trend is to discriminate against the prudent management of our common-property, renewable resources. In a society where decision-making horizons have shrunk to five years or less, how is a case made for investment in renewable resources that may not show a return for decades? The answer, of course, is that the case must be made very carefully. Natural resource management objectives are set that the resource can sustain over time and that are consistent with public desire. Institutional resources are detailed that will be required to meet those objectives. Finally, the consequences of not being given those resources are clearly defined. Once again, that is planning. And it is a fairly specific level of planning that is currently being called strategic planning in planning jargon. What I intend to do in this presentation is provide an historical background to strategic planning, place it in the context of other planning processes, and describe its major components using wildlife planning as an example.

HISTORICAL BACKGROUND

If time periods can be categorized, then the period from the mid-1960's to the early 1970's could be termed the era of confrontation. Few mechanisms existed for resource management integration and fewer still ensured consideration of environmental values in resource development. It was a time when, if strong legislation existed, you could command people's attention. If you did not, you had to find other means. The strategy chosen by conservation agencies can best be described by the story of the rancher who was not getting the calving rate he figured he deserved and decided to bring in another bull. The three incumbent bulls got to discussing this and the biggest said, "He can't have any of my 50 cows". The middle sized said, "He certainly can't have any of my 35 cows". And the smallest said, "Well I only have 10 cows, so I can't be expected to share". Came the day of the new arrival, the three incumbents wandered down to the holding pen and there was the new bull--immense, with angry little red eyes, and steam puffing out of its nostrils. The first bull said, "You know, it's only Christian to share. He can have 20 of my cows". The second bull said "Yup, no problem there, he can have 15 of my cows". But the smallest began to paw the ground and charge around butting fence posts. "My God!" said the first bull, "You're not going to fight him are you?" To which the littlest bull replied: "Hell no, I just want to make sure he realizes I'm a bull!" Or, in the vernacular of today, if you were a small agency, short of funds and staff, with impotent legislation, you had to run pretty fast and make a lot of noise just to keep from being screwed. This sometimes took the form of an interview with the nearest environmentally sympathetic newspaper reporter, or the informal press release in a plain brown envelope. This tactic had some nasty side effects, however. It tended to alienate ministers, and to prematurely age senior staff. Late this afternoon, when Don Robinson totters up to the podium, I am sure you will find it hard to believe that the man is only 29.

But, we got people's attention. And the first to respond, to their credit, was the Forest Service. The first attempt by the Forest Service to give the Fish and Wildlife Branch a piece of the action was the forest folio process. We went to all those meetings, we colored all those maps, and 70% of the time things went pretty well. But then we started asking for reservations of mature timber on Vancouver Island for salmon stream protection and a range of mature forest-dwelling wildlife. The answer was, "You can't do that, you'll affect the A.A.C.[1]" "Oh well," we said, "how about reserving some of this medium-poor site, overmature subalpine for caribou?" And the reply was, "Get your hands away from that, we're having timber supply problems and we're going to need that to sustain the A.A.C." Suddenly we learned a lesson about participating in planning processes where most of the major decisions had already been made by somebody else at a much higher level.

Even where the Forest Service was willing to compromise, we found ourselves being asked embarassing questions like: "Gosh, it's going to cost us a lot of money to avoid that area, how important is it?" "Uh, gee" we'd say, "it's pretty important habitat." "O.K." would come the inevitable reply, "but how many animals is enough?"

Even Coordinated Resource Management Planning, one of the most successful integrated planning processes in this province, is largely a gentlemen's agreement towards a better distribution of the range resource amongst existing users over the short term. It has not rovided us with any long-term protection of the range from a host of conflicting uses.

The point is, I think, that pragmatic, operational planning processes, no matter how well conceived, cannot be fully effective in a policy vacuum. We were constantly being invited to participate in operational level planning processes initiated by people who had a clear idea of what their management objectives were. We had no such idea, and even if we had, operational planning was an inappropriate level to attempt to integrate resource management objectives. Environmental resources should be considered in their own right, not as an appendage to someone else's program.

Other jurisdictions, notably Ontario, have taken the opposite tack and are planning from above. However, instead of limiting plans at the provincial and regional level to broad policy plans, they have attempted to establish management targets. The problem is that at the regional and provincial levels it is easier to estimate demands for a resource that it is to determine factors of supply. Reports at recent interprovincial meetings indicate that Ontario is now mired at the operational level of planning, realizing that they cannot hope to meet all of their demand-oriented objectives. What becomes apparent is that we cannot plan at one level. Provincial and regional policy plans are necessary to give broad, long-term direction. Operational planning is necessary for effective, site-specific action programs. But between these is a planning level that has previously been missing. It is the level at which one can conveniently consider both resource supply and demand, and thus define rational resource management targets. This level is the most appropriate, not only for setting individual resource management objectives, but also for the integration of objectives between resource sectors. The Ministry of Environment has defined this level of planning as strategic planning; its relationship to other planning levels is shown in table 1.

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[1] A.A.C. denotes annual allowable cut.

During the recent reorganization of the Ministry of Environment, the ministry executive pointed out the lack of explicit environmental management objectives. The resultant reorganization document decreed that the ministry would undertake coordinated environmental planning at the strategic level as a vehicle for establishing explicit environmental management objectives, integrating the various programs and disciplines of the ministry, and for developing the ministry budget.

In order to implement this planning process the ministry has established 38 strategic planning units, based on major river basins, at a level below that of the resource region (fig. 1). The number of planning units per region varies from four to six. These 38 planning units have been priorized and scheduled for planning over the next eight years.

The ministry also made provision in its reorganization for a planning branch, comprising a small group of resource planners and economists. The branch is charged with the responsibility for providing planning and socioeconomic services in the preparation of strategic plans to both headquarters and regional management staff.

The main goals of strategic resource planning have been defined as follows:

1. To determine, for those environmental resources within the ministry's mandate--fish, wildlife, water resources, water quality, air quality, and marine resources--both present and projected demands, and present and potential resource supplies.
2. To assess the options for environmental management and to evaluate the benefits and costs of these management options.
3. To set environmental management objectives that are consistent with provincial and regional goals.
4. To develop the specific management programs necessary to achieve the management objectives. These programs provide context and direction for the preparation of site-specific action plans at the operational planning level.

What I intend to do in the remainder of this presentation is to take these four major objectives and break them down into the specific components of a strategic plan for wildlife management.

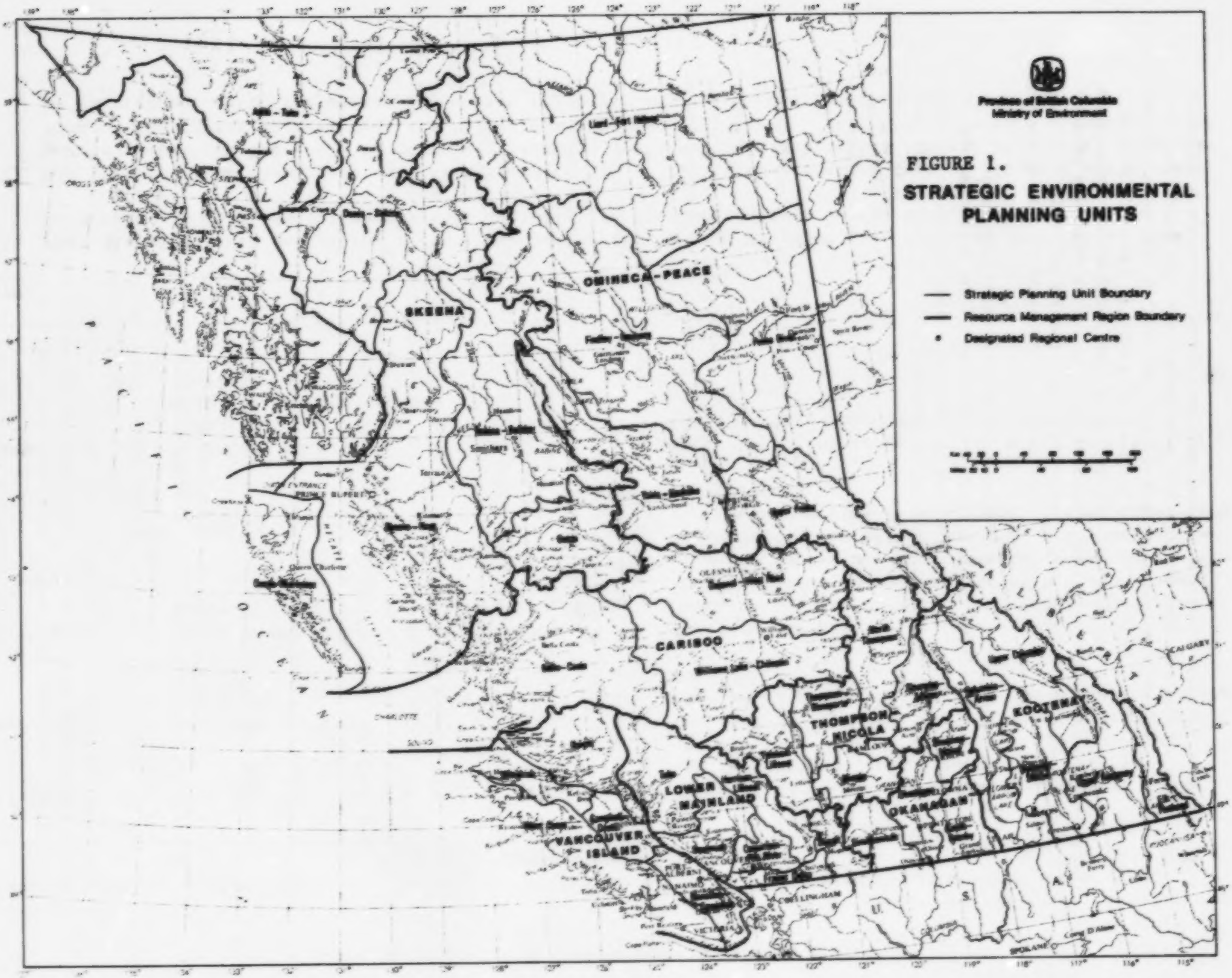
TABLE 1. Levels of environmental resource planning

Planning level	Planning unit	Scale of data presentation	Planning characteristics
Provincial	Province	1:2,000,000 or smaller	Broad policy plans establishing long-term goals for environmental management.
Regional	Resource Region	1:500,000	Specific policy plans establishing environmental management priorities for a 10 to 20 year planning horizon.
Strategic	Major River Basin Major Air Shed	1:100,000- 1:250,000	A management plan establishing quantified resource management objectives for the planning horizon, based on an analysis of both the demand for, and supply of, environmental resources. Sets out management programs for a 3 to 5 year management period designed to accomplish the longer-term objectives.
Operational	Tributary Watershed Small Air Shed Wildlife Management Area Specific Land Unit	1:10,000- 1:50,000	Short-term, intensive, action plans specified by the strategic management program statements.

NOTE:

(i) Most planning texts define the first three levels of planning shown on this table as strategic. Thus strategic planning, as defined by this ministry, is the lowest level of the more general definition.

(ii) All organizations also carry out, either explicitly or implicitly, another type of planning called corporate planning. The realm of corporate planning deals with the administration and structural organization of the agency to best meet its resource management objectives. Effective corporate planning cannot be carried out until the agency knows what its major objectives and functions are.



Province of British Columbia
Ministry of Environment

FIGURE 1.

STRATEGIC ENVIRONMENTAL PLANNING UNITS

— Strategic Planning Unit Boundary
— Resource Management Region Boundary
• Designated Regional Centre

OMINECA-PEACE
SKEENA
CARIBOO
THOMPSON-NICOLA
OKANAGAN
KOOTENAY
LOWER MAINLAND
VANCOUVER ISLAND
PACIFIC OCEAN
HECATE
PRINCE RUPERT
CHARLOTTE
CALGARY
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STRATEGIC PLANNING FOR WILDLIFE

For the strategic planning process to function effectively it must be guided by provincial and regional policy statements. In this regard, the wildlife program is some years ahead of other sectors of the ministry, largely due to the foresight of headquarters program staff and regional biologists. The provincial and regional wildlife policy statements provide guidance for strategic planning by defining species management priorities for the planning unit and placing population levels in a regional and provincial context.

The seven components of a strategic planning process for wildlife are shown in table 2, and each component is described in more detail in the following sections.

TABLE 2. Components of a strategic planning process for wildlife

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1. Define a time frame for planning.
2. Determine demand for and supply of wildlife now and in the foreseeable future.
3. Define and assess management options.
4. Choose management objective for each species.
5. Develop management programs.
6. Prepare annual working plans.
7. Monitor and assess progress.

Repeat at the end of the management period.

Definition of Time Frame

Any planning enterprise requires medium to long-term direction and the period over which this direction is given is termed the "planning horizon". The period chosen for the planning horizon depends on a number of factors, including the ability of managers to confidently project the supply and demand relationship over time, and the lag-time necessary for the benefits of management activities to be realized. Given the characteristics of wildlife management, the planning horizon is likely to lie in the 10 to 20-year range.

If the resource information base were adequate, managers could plan for the long-term horizon. But this is seldom the case. Knowledge of both resource productivity and changes in public attitudes is very poor. In addition, events are constantly occurring, both human-caused and natural, that have significant impacts on the supply and demand relationship. Therefore, although management activities are designed to meet long-term goals over the planning horizon, a shorter "management period" is necessary for program and budget development. The management period allows ongoing management refinement as the information base improves, a continuing response to uncertainty and the inevitable "surprises" and, perhaps most important, periodic review of the long-term direction to determine whether it is still valid. The more uncertain our knowledge, the shorter will be the management period and the greater the proportion of data gathering to active management activities. The better our knowledge becomes, the more closely will the management period approach the planning horizon. Given the current state of our knowledge, it is unlikely that the wildlife management period will exceed five years.

Supply-Demand Analysis

Present and potential wildlife supply is a function of the following:

- Habitat Considerations
  - Capability and carrying capacities
  - Present condition
  - Degree of use
  - Enhancement opportunity

- Population Considerations
  - Present distribution
  - Present numbers and trends
  - Population age and sex structure
  - Population factors limiting productivity

- Conflicting and Complementary Land Uses
  - Land use
  - Land tenure
  - Zoning
  - Access and linear developments

An analysis of demand must accommodate the full range of public values relating to wildlife, including the following major components:

- Nonconsumptive recreational demand

- Consumptive recreational demand

- Ethical or scientific demand for preservation of gene pool and diversity

- Commercial demand for trapping and guiding.

Projection of demand requires both an estimation of human population growth and an assessment of changing public attitudes and expectations. Whether as full an analysis as is implicit in the foregoing description is carried out in practice will depend upon two considerations:

1. Is the information base sufficient to support such an analysis?

2. Is such an analysis warranted given the level of management that is anticipated over the foreseeable future?

Definition and Assessment of Management Options

The results of the supply-demand analysis will determine the range of available management options. The relationship between particular supply and demand situations, and management objectives and programs are shown in table 3.

Once the range of management options has been defined, the most realistic options can be weighed according to a number of criteria, to determine which will be chosen as the management objective for the planning horizon. The assessment criteria used would be some or all of the following:

- Economic criteria such as
    - benefit/cost
    - cost effectiveness
    - opportunity cost

- Public acceptability

- Ethical acceptability

- Conformity with provincial and regional policy

Choice of Management Objectives

The assessment of management options leads to the choice of a management objective for the appropriate planning horizon. Wherever possible, objectives for wildlife management should be stated in terms of a desired population size, of an optimum geographic distribution, and with a stated age-sex structure for each priority wildlife species.

Development of Management Programs

Program statements at the strategic level indicate broadly the activities that will be undertaken, over the management period, to meet the management objectives. General program areas for wildlife will include: population management, recreation management, land zonation and habitat acquisition, habitat management including the full spectrum of activities from protection to enhancement, inventory and research, access control, and management of impacts of other land use activities through compensation and mitigation. These management program state-

TABLE 3. Definition of management options

Supply/demand relationship	Probable management objective	Management programs
Cannot be determined	Maintain present populations	- Set conservative use levels - Protect habitat and manage impacts of competing land use activities - Undertake inventory and research to quantify supply and demand
Supply > Demand	Maintain present populations	- Identify and preserve options for future - Enhance demand if appropriate
Supply < Demand Supply < Capability	Increase populations to a desired level	- Manage demand in interim - Enhance supply - Protect habitat and manage the impacts of competing land use activities
Supply < Demand Supply = Capability	Maintain present populations	- Manage demand - Protect habitat and manage the impacts of competing land use activities

ments provide a context for the development of site-specific plans at the operational level. A strategic plan should indicate what activities would be carried out in the planning area and where those activities would be directed. How they would be carried out is an operational level consideration. For example in order to meet a given population objective it might be recommended in a strategic plan that X hectares of a certain quality habitat is required in the planning unit, Y hectares currently exist in that state, and areas A, B, and C represent the most cost-effective opportunities for enhancement. Operational plans would then be prepared to define the techniques to be used and the site-specific details of enhancement.

Preparation of Annual Working Plans

The final step of the strategic plan is the preparation of annual working plans. These will present program details and budget projections for each year of the management period. The importance of these annual working plans is their ability to be used to indicate the ongoing nature of renewable resource management; unlike the "one shot" nature of some management enterprises, renewable resources require continual husbandry.

Monitoring and Assessment of Progress

One of the most important components of any management plan is the assessment of progress to determine whether objectives are being met and, if not, whether corrective measures should be taken. This is one of the major reasons for insisting that management objectives be stated, wherever possible, in quantitative, measurable terms. With wildlife management, monitoring and assessment programs most likely focus on three areas: population census, habitat condition surveys, and surveys of public satisfaction.

BEYOND STRATEGIC PLANNING: RESOURCE MANAGEMENT INTEGRATION

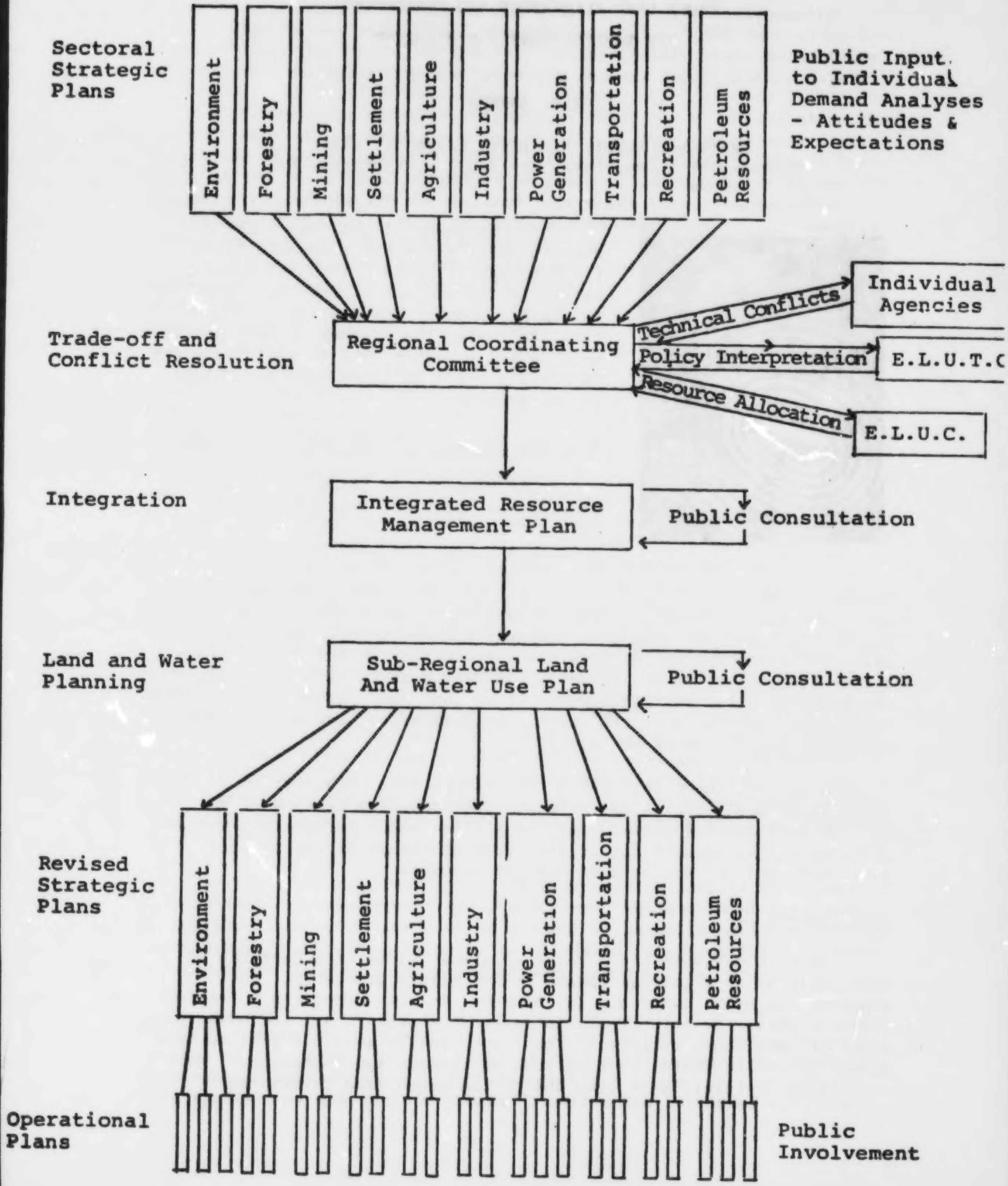
What I hope has come across clearly from this presentation is that the strategic environmental management plans currently being prepared by the Ministry of Environment will be advocacy documents. Though an attempt will be made to keep each plan as compatible as possible with other land-use interests in the planning unit, conflicts will surely arise. The environmental management plans will identify those points of conflict, establish clearly the environmental resources involved, and outline the implications of trade-off options so that informed decisions can be made at senior levels of government. In this respect, they are similar to other strategic level planning processes such as the timber supply analysis of the Forest Service, subdistrict planning by the Provincial Parks Branch, settlement planning by regional districts, and power generation planning by B.C. Hydro. Recently, the Ministries of Municipal Affairs and Agriculture have established strategic planning units. In fact, planning strategically has become "the thing to do" in the provincial government. That these government agencies are presently developing their strategic plans in relative isolation is not as bad as it might first appear. As mentioned elsewhere in this presentation, one of the major problems with earlier attempts at interagency planning was that few agencies had clearly-stated resource management objectives and programs to bring to an integration process. The present dilemma is that once these sectoral management statements are prepared, we have no formal, comprehensive process of integration and conflict resolution.

In a few months time, a proposed Land Use Act will be tabled in the Legislature, which promises to provide a formal process for integrating resource management in British Columbia. Without trying to second-guess the bill, I would like to speculate a little on how that integration might be most effectively carried out. A process for resource decision-making based on strategic planning is outlined in figure 2. The vehicle for integration is a regional coordinating committee (RCC), much like the current regional resource management committees but with the addition of local government planning staff. This committee acts not as a decision-making body, but to identify major points of conflict between strategic plans and to direct such conflicts to the appropriate level of government for resolution. Thus, the RCC might direct a conflict between two individual agencies if it was deemed of a technical nature to the Environment and Land Use Technical Committee for policy interpretation, or to the Environment and Land Use Committee of ministers in the case of a conflict involving resource allocation that lies outside existing policy. After the process of trade-off and conflict resolution is complete, the RCC coordinates the preparation of an integrated resource management plan consisting, primarily, of the revised and integrated management objectives for the various sectoral areas. Public consultation would be an important component of this step of the process, allowing public scrutiny and comment on the range of trade-off options considered. The mechanism that allows the implementation of the sectoral strategic plan is the allocation of the land and water base. Land and water are the primary resources that can be used to produce a mix of commodities--wildlife, fish, food, wood, minerals, energy, shelter, and so on. Before the land and water base can be equitably allocated, society must decide which of these commodities it desires and in what proportions. This guidance is provided by the integrated resource management plan; and the responsibility for the efficient allocation of land and water to enable the implementation of that plan lies with the land managers in the Ministries of Forest and Lands, Parks and Housing, and water managers in the Ministry of Environment. With the consignment of a land and water base to work with, individual agencies can then get on with the job of developing management programs and operational plans for their respective resources.

CONCLUSION

I have been asked by a number of skeptics how many animals strategic planning will save. The honest answer to that question is perhaps none. Planning is not a panacea for all of the perceived resource management ills of the province. It can, however, be a tool that leads to better, more explicit decisions. Good planning should consider both public demand for a resource and the levels of use that the resource can sustain over time. It should indicate the costs of management actions and the points of conflict with other resource uses. Finally, it should define the resource values involved in trade-off decisions, the options that exist for conflict resolution, and the implications of those options. If these considerations can be laid out clearly for political decision-makers and the public, then planners, particularly in the public service, will have fulfilled their responsibilities. It is then up to society, through its elected representatives, to make wise choices that balance present benefits against the maintenance of the widest possible array of future options.

Figure 2. Strategic level resource management integration


Sectoral Strategic Plans
Environment
Forestry
Mining
Settlement
Agriculture
Industry
Power Generation
Transportation
Recreation
Petroleum Resources
Public Input to Individual Demand Analyses - Attitudes & Expectations
Individual Agencies
Technical Conflicts
Trade-off and Conflict Resolution
Regional Coordinating Committee
Policy Interpretation
E.L.U.T.C
Resource Allocation
E.L.U.C.
Integration
Integrated Resource Management Plan
Public Consultation
Land and Water Planning
Sub-Regional Land And Water Use Plan
Public Consultation
Revised Strategic Plans
Environment
Forestry
Mining
Settlement
Agriculture
Industry
Power Generation
Transportation
Recreation
Petroleum Resources
Operational Plans
Public Involvement

CROWN LAND ALLOCATION AND MANAGEMENT: THE IMPLICATIONS FOR WILDLIFE

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The purposes of this paper are to discuss briefly how the responsibilities of the Ministry of Lands, Parks and Housing relate to the subject of land for wildlife, to explore some of the demands on Crown land, to review the history of land management in the province, and to anticipate the future direction of crown land management in the province.

Ministry of Lands, Parks and Housing Role

The Ministry of Lands, Parks and Housing has important responsibilities through the Ministry of Lands, Parks and Housing Act, and the Land Act, and the Park Act for allocation and management of provincial crown land. Its role includes not only allocation and management, but also conservation and protection of crown land having regard to the immediate and long-term economic and social benefits this resource may confer on the province. Protection refers to the capability and quality of public land. In co-operation with other agencies, the ministry plans and administers crown land use. Crown land includes not only upland but also the freshwater, estuarine, and marine foreshore and lands covered by water.

A central theme which will run through this presentation is that crown lands are a finite resource and the competing demands of an increasingly complex society for these lands makes integrated land use planning and management one of the critical issues of the day for government and all citizens of British Columbia.

Land Demands

British Columbia has a total of almost 95-million hectares of land, only 5% of which has passed to fee simple ownership. The apparent 95% crown ownership is, however, heavily committed to various resource uses. So this figure is somewhat deceptive and includes vast areas of land whose utility for most purposes is severely limited by a number of environmental factors such as climate and topography. Over 34-million hectares, more than 40% of the crown land in British

Columbia, are occupied by alpine and subalpine tundra environments alone. This leaves only 55% of the province below 3,500 feet elevation. It is this land which currently supports most resource activity in this province and where most resource demands and conflicts exist.

What are these demands? Clearly, a major one is generated by the forest industry. In economic terms the forest industry is very significant; it directly employed 10% of the labor force and accounted for $7.3 billion in value of shipments in 1980. Thus, there are strong economic reasons why the forest land base needs to be protected to ensure a wood supply to keep existing plants operating. Approximately 32-million hectares of productive forest land are currently reserved as provincial forest. An additional 43 provincial forests are presently proceeding to designation which will almost double the land area in provincial forests. As a result, the amount of Crown land available to meet the demands for land not satisfied under the forest management allocation will be substantially reduced. Yet the Ministry of Forests' forest and range resource analysis also predicts that 12-million hectares of forest land will be taken out of production by the year 2000. While land use for forestry is dominant in British Columbia, it too is under pressure.

This is only one of many demands. Recreation needs continue to grow based in some measure on continuing strong economic growth of the province. Over the past several years there has been a steady increase in demand for rural private properties and for public recreation facilities including ski slopes, campgrounds, parks, beaches, and wilderness areas. These uses all require land; in some cases, their impacts extend significantly beyond the actual site.

There are also mineral and energy-oriented demands. A significant and steadily increasing proportion of the province's economy is directly dependent upon mineral, petroleum, and natural gas resource extraction. While extraction per se involves a relatively insignificant amount of land, exploration activities take place over extensive tracts in many parts of the province and the servicing of extraction requires further land. The demand for hydroelectric energy requires large reservoirs that occupy areas of land which are invariably of high capability for other resource uses. The same is true of power transmission lines.

Agriculture requires land. The government's goal is to increase self-sufficiency in agricultural production. While much of this will be achieved with more intensive management of existing agricultural land, crown land will continue to be allocated to agricultural production where it is deemed to be the highest and best land use.

Demands for land for wildlife are also significant. The Fish and Wildlife Branch has estimated that, in order to maintain present populations of ungulates alone, a total of 6.75 million hectares, strictly proportioned between several different habitat types, is required. This figure does not include habitat requirements for other wildlife categories such as waterfowl, upland game birds, fur-bearers, anadromous or other fish species, although there is certainly some degree of overlap between the spatial requirements of different species groups. Fortunately, wildlife can often be managed with other resource uses, given careful planning. There are, however, cases where wildlife management requires virtually single-purposes allocation.

There are innumerable other demands as well, each in itself relatively minor in magnitude but together adding significantly to the total demand for crown land in British Columbia. These demands include requirements for watershed land to ensure that settled areas have ample supplies of fresh water, requirements for linear corridors such as roads, highways, and power transmission lines, and requirements for settlement, commerce, and industry.

Obviously, despite the illusion of wide open spaces and unlimited resources, the British Columbia land base is finite, heavily committed, and under strong demand. It has been the experience in the Ministry of Lands, Parks and Housing that any land decision involves at least two competing interests, no matter how remote the area under consideration. These problems of competing demands and conflicts lead us to ask the question of how can we best plan and manage our land and resources to achieve the broad range of British Columbia's environmental, economic, and social goals and objectives. In addressing this question, it is useful to review past and present practices in land administration.

History of Land Administration

Lands were first considered part of the public domain to be managed on behalf of the public with a government proclamation of 1859. Since this initiation of public land administration in British Columbia, there has been a continuous evolution in response to changes in public consciousness and philosophy regarding resource values. A significant part of the British Columbia heritage rests in the proclamation which reflects a philosophy that the resources of the province be managed in the public domain.

Initially, land allocation and disposition occurred with the development of new settlements. The primary function of government at this stage was no more than a simple record keeper and registrar of individual rights to the land. The reasons for this are many, but in essence it can be stated that this limited role reflected the frontier stage of development that characterized North American civilization through much of the last century and the first half of this one. This philosophy was based, in part, upon a perception of unlimited supply of resources. Land use planning and management were not major government activities.

During the middle years of this century, the role of government in land administration started to change. This was primarily in response to an awareness that there were, in fact, land use constraints to continued economic growth and prosperity. Through these years, an increasing number of governmental agencies and subagencies were established, each with a responsibility for managing a particular resource or combination of resources. Each began to play an increasing role in resource allocation and management decisions. Crown land administration became more than simply the keeping of records on the disposal of land. Such functions as determining the suitability of land for a particular use, assessing competing uses, and managing uses were added to the land administrators' job.

Out of this evolved the referral process. Before a decision on crown land use was made by a land administrator or manager, the opinions of other agencies, including local and federal levels if considered necessary, were solicited. Today, the referral process is mandatory on all crown land applications. This does not mean that resource agency comments are always adhered to or implemented by land managers when making decisions, but they are taken into consideration. Responsibility for either approval or rejection of a crown land application continues to rest with the Ministry of Lands, Parks and Housing.

As indicated a few minutes ago, these decisions are becoming increasingly difficult to make as various resource demands for a diminishing crown land base become more intensive. Although opportunities for integrating one use with others may exist, in many cases this is not practical, particularly for those types of uses administered by this ministry. Where application for alienation of land is involved, a decision to approve the use generally implies the exclusion of other uses for that land. Since the land may be capable of supporting several different uses such as agriculture, forestry, and wildlife habitat, the merits of not only which single use of the land is most suitable, but also the possibility of integrated resource use must be considered.

To assist in decision making on crown land uses, the Ministry of Lands, Parks and Housing initiated in 1978 a relatively comprehensive crown lands planning program. Referred to as the crown Land Planning Program, it involves a hierarchy of planning levels ranging from the broad provincial level to detailed site planning. These plans, although prepared by this ministry, are in reality a joint undertaking with other resource agencies being represented on a task force and opportunities for public involvement. It is the task force which sets the plan objectives, reviews the data and analysis, and makes a recommendation for approval of the plan.

Most crown land plans currently being undertaken by this ministry are at the subdistrict level (approximately 1:50,000 scale). A subdistrict crown land plan essentially involves the preparation of several alternative plan concepts based on the demand for, and supply of, crown land. A key step in this process is determining land use suitability. For example, wildlife suitability would be based on present land use, site disturbance, adjacent land uses, proximity to settlement, land capability for ungulates, waterfowl, furbearers, nongame mammals, large carnivores, upland game birds, and other factors.

Land suitability for other resource uses are derived in a similar manner. Several sets of rules for comparing one land suitability with another are then determined consistent with the plan objectives, and concept maps drawn reflecting these rules.

There are several ways of securing land for wildlife. Most often areas of high wildlife suitability would generally be set aside. The land can be reserved under the Land Act. It is also possible to transfer administration and control of crown land to the Ministry of Environment by Order-in-Council under Sec. 101(e) of the Land Act. This procedure usually means this land, managed by the Fish and Wildlife Branch, is used exclusively for wildlife. Section 13 of the Land Act also provides for land designation for a specified use and exclusion of incompatible uses.

Areas of moderate and low wildlife suitability, which overlap with lands suitable for resource uses compatible with wildlife use, would likely be managed on an integrated basis in consultation with other resource managers. However, if the overlapping resource use is incompatible with wildlife management, as with agriculture, a trade-off would have to be made either for alienation or for preservation. Suffice it to say that a land for settlement or development is designated in a crown Land Plan only after a relatively comprehensive examination of other resource values.

It is apparent that in most cases the approval of land dispositions has reduced the quantity of wildlife habitat in this province. In some areas, even critical winter range habitat areas have been lost. However, a substantial number of reserves for wildlife management purposes have been established pursuant to Section 11 or 12 of the Land Act. And ecological reserves have also been created to preserve rare, unique, and endangered native plants or animals in their natural surroundings. There are 105 such reserves in British Columbia and the 85,070 ha they cover constitute a significant reservation of habitat for wildlife.

Revenues from the Crown Land Fund are being used to assist in the purchase of critically important wildlife habitat areas currently held in private ownership. Since the inception of the Habitat Conservation Fund Program two years ago, $2.5 million have been allocated to it from the fund. The purchasing program is organized by the Ministry of Environment. Assistance is available from Lands, Parks and Housing concerning the mechanics of acquiring title.

The ministry maintains a register of Greenbelt Reserve Lands which currently lists 112 areas covering 9777 hectares. The largest units have been transferred to the Fish and Wildlife Branch for management. The Habitat Conservation Fund Program supplants the use of greenbelt legislation to acquire wildlife habitat, but existing greenbelts contribute to habitat protection.

These and other programs should improve not only in the amount of wildlife habitat but also its quality. The Ministry of Lands, Parks and Housing has no reluctance about reserving more land for fish and wildlife habitat where it can be justified.

The system of provincial parks, recreation areas, and wilderness conservancies, which embraces 363 units, includes 4,573,021 ha of land where wildlife habitat is protected. While the focus of this paper is on crown land disposition to the full range of uses and consideration of land for wildlife in this context, the maintenance of the ministry of these wildland parks is a contribution of land for wildlife that merits mention.

Recent press coverage which has sensationalized this ministry's land disposition process and intentions has largely proved unfounded. Obviously there will be differences in opinion as to the rightness or wrongness of some land use decisions. Some land use decisions made by this ministry may have been wrong. However, it would be erroneous to suggest that there was no attempt to think through the resource implications prior to a disposition being made. Our ministry's commitment to the planning process is a good indication of our willingness to improve the quality of our decision-making.

We are also committed to public involvement in the planning process. We have held open house public meetings for several plans in various parts of the province such as Foreshore Plan, Ladysmith Harbour on Vancouver Island, Sicamous Narrows in the Thompson-Okanagan, and the Prince George Special Sales Area Crown Land Plan in the Omineca Region. Some of you may have participated in these projects. Our experience to date with public involvement has reinforced our belief that the public good is well served by this process. Land use decisions based on such a process have a broad level of public support, and even when a decision is disappointing to a particular interest group, at least both public service staff and interest group members have a better understanding of each other's viewpoints and concerns prior to, rather than after, the decision.

Now, back to the question that was raised earlier. How can we best plan and manage our land and resources to achieve the broad range of British Columbia's environmental, economic and social goals and objectives? There are government programs and activities that are in place and others under development that contribute, or will contribute, to better land use decisions.

A process is being developed for the integration of land use policy and programs of government. At the most senior level is the Environment and Land Use Committee (ELUC), a cabinet committee of nine ministries established under the authority of the Environment and Land Use Act. The Environment and Land Use Technical Committee, and the Regional Resource Management Committee provide for: interagency coordination for resource management and allocation programs, resolution of resource issues, and advice to ELUC on resource policy, programs and issues. Land use policy and planning decisions generally affect more than one agency; the establishment and operation of these committees for purposes of liaison and decision making is an important component in the overall game-plan to achieve better land use decisions.

Many of the resource ministries of government have, or are developing, strategic planning programs. By this, I mean a process of: determining what level of production should be achieved in each resource sector; reviewing the alternatives for achieving these production targets; and selecting and implementing the most appropriate alternative.

The Ministry of Forests has a forest and range resource analysis at the provincial level and a timber supply area analysis at the subregional level that establishes resource production targets and strategies for achieving these. This Ministry of Lands, Parks and Housing is implementing a similar type of process called tactical planning that will define its production targets such as recreational cottage lots and rural residential subdivisions and how these will be achieved. This Ministry of Environment has developed the concepts of a strategic planning program and is in the process of implementing these ideas for the fish, wildlife, air, and water resources. The Ministries of Agriculture and Food and Municipal Affairs have also initiated strategic planning programs.

The further development and integration of these programs should provide a sound basis for allocating and managing the land resource for a broad spectrum of uses in British Columbia. These programs will provide information for the development of provincial and regional land use policy and strategies. Although the development of provincial and regional land use policies is only in its infancy, increasingly it is gaining a broad-based recognition as an essential requirement for making wise land use decision. Together, ministry planning programs, such as the Ministry of Lands, Parks and Housing's Crown Land Planning Program, the various strategic planning programs being developed, and the development and implementation of provincial and regional land use policies provide the basic ingredients for better land use decisions. These processes and plans will ensure that wildlife needs, like other land use requirements, are reflected in land use strategies. Implementation can ensure the achievement of broad provincial objectives including specific wildlife objectives and targets in an integrated manner.

MINISTRY OF FORESTS' PARTICIPATION IN WILDLIFE HABITAT MANAGEMENT

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"Forest and Range Facts, 1980-81", published by the Ministry of Forests, sets the area of forest land in the province at 52-million hectares. It further states the area of range land administered by the ministry to be 10-million hectares.

The ministry is charged by the Ministry of Forests Act to encourage maximum productivity of the province's forest and range resources. The act further charges that this production be managed through multiple resource use planning processes.

The chief forester is empowered under the Forest Act to determine rates of forest harvest (allowable annual cut) that may be sustained in management units. In so doing, he is charged under this act to consider among several other items such as "constraints on the amount of timber produced from the area for purposes other than timber production". That is, to consider multiple resource use concepts. Thus, by legislation and by action, the ministry is committed to multiple resource use management regimes.

So much for words. Now what actually happens out there, what does multiple resource use management mean in terms of participation or impacts on wildlife habitat? Some general principles involved are:

(i) because we machine-age human animals are using forest and range land products to pay for our ways of living we alter wildlife habitat. We have created access where there was none, we have reduced the extent of old growth forests, and so on.

The alteration started when Europeans poked their prows into Nootka Sound and when MacKenzie crossed the mountains. It will continue and the forests will never be the same again.

(ii) the Ministry of Forests must be seen foremost as participators in wildlife habitat management--not the managers. Management practices are defined by wildlife managers.

(iii) the Ministry of Forests is able to participate in wildlife habitat management through modification of forest and range management practices which may result in reduced rates of harvest and increased costs in harvest and management regimes.

In the forestry sector there are many modifications in management practices which are available and have been used. Some examples are:

- exempting land from harvesting or treatment for a short or long period of time.
- altering cut block size.
- altering cut block sequence.
- modifying harvest practices.
- modifying logging methods.
- modifying access schedule and location.
- modifying regeneration methods--time, choice of species.
- modifying cultural practices--stand density, site treatments.
- using burning to improve habitat.

Those are operational practices and more about them later. But let us start at the top with Ministry of Forests participation and liaison on this habitat topic.

Ministry of Forests Periodic Resource Analysis (PRA)

All other resource ministries contributed to the Ministry of Forests' Periodic Resource Analysis presented as required by legislation to the cabinet in the fall of 1979. Part of the Fish and Wildlife Branch's contribution was an outline of six major areas in which forest and range management practices affected, or are related to, fish and wildlife resources.

These are:

1. Climax Mature Timber

   Dependence of certain wildlife species on climax mature timber for wintering habitat--black tailed deer on the coast; caribou in the interior.

2. Critical Habitat Sites

   Requirements for preservation of critical wildlife habitat through special silvicultural prescription--nesting sites and calving grounds.

3. Controlled Burns

   Controlled burns for silvicultural purposes can be employed to generate benefits for wildlife and livestock. Successes have been experienced, for example, in the Kootenays and northern Omineca-Peace regions.

4. Forest Roads

   Forest road design, construction, and maintenance can have significant effects on land and water habitats. Access control is also a significant factor.

5. Water Environments

   Effects of forestry operations on the estuarine and littoral environments were noted as related to log dump and booming grounds.

6. Excessive Grazing

   Grazing requires control in some areas of the province where excessive use can lead to alteration of the vegetative composition of ranges, erosion of the soil mantle, competition for the winter forage needs of wild ungulates, and loss of ground cover for smaller forms of wildlife. The forest and range production targets identified in the Periodic Resource Analysis were influenced by those factors insofar as they could be related at that broad regional and provincial level of estimation and assumption. Environmental protection area influence was also related through staff discussion at provincial and regional levels.

Environmental Protection Areas (EPAs)

These are areas identified by forest inventory crews during their field work. They specify areas that are especially sensitive from the point of view of resource values other than harvestable timber--soil, water, wildlife, and special forest practice considerations. Documentation is available in handbooks and manuals from the Forest Inventory Branch of the Ministry of Forests.

Timber Supply Areas (TSA)

These are forest management units in which the chief forester must assess timber supply and demand and determine an allowable annual cut--or timber harvest production target--coordinated with major aspects of the Periodic Resource Analysis and other factors more specifically related to the TSA. The EPA system of highlighting multiple use concerns is especially influential here in short-term harvest plans for the TSA and indeed in subsequent subunit plans and harvesting operations.

The PRA and TSA programs provide the higher level management attention to participating in wildlife habitat management, an assurance that harvest rates are not predicated on single-use timber harvest regimes for all forest and range land areas.

Under the guidance of those "umbrellas", the real participation takes place on the ground--in the field--where the action is. It is possible in this short presentation to highlight only a few examples of what is taking place.

First of all, a look at some of the big ones, the subunit folio plans for harvest which have been developed for coastal watersheds--Nahmint, Tsitika, and Koprino in the Vancouver Region. Among much other good multiple resource management work, harvesting prescriptions were developed for protection of wildlife values in developing these plans. And more important of course is that implementation has followed successfully. That is they were not paper plans, developed and not followed, but useful tools for Ministry of Forests participation in wildlife habitat management.

In our Caribou Region there are three examples to illustrate another form of participation.

1. An excellent example was the proposed crossing site of Kimball Creek as part of the Cunningham Forest Road. Construction of the proposed bridge could affect silt loads within the stream and stream meander pattern thereby altering the excellent spawning habitat for rainbow trout and Dolly Varden char in Kimball Creek. As a result the crossing was moved approximately 200 meters upstream to an area that would be less sensitive.

2. In the Gaspard C.R.M.P. critical wintering areas for wildlife were delineated and logging designed on the basis of wildlife needs first and forestry second. In noncritical areas logging was designed on the basis of forestry first and wildlife requirements second. Guidelines for cutting-block design were developed in consultation with the Fish and Wildlife Branch and involved such considerations as block shape, size, location, season of cut, regeneration, and road layout.

3. In the Big Creek Area (C.P. 44 of T.S.H.L. A01891) proposed cut blocks were changed to accommodate wildlife use of the area adjacent to a critical winter range along Big Creek. It was also recommended that no cutting should take place east of one of the blocks in order to maintain sufficient cover adjacent to feeding areas.

Nelson Region's Protection policy includes two objectives related to wildlife habitat in their 5 Year Forest Protection Plan:

1. to maintain a variety of habitat management options, and

2. to manage critical habitat areas for the purpose of wildlife in integrated resource management.

To meet these objectives they plan to burn 2000 ha of range land per year, not only for range, but for wildlife habitat. During the past year they burnt some 1700 ha. This year they have done some extensive burning in the East Kootenay and the Pend-d'Oreille areas of this region.

Another example from the Kamloops Region is an instance where logging plans were altered to protect deer beds on one of Weyerhaeuser's operations in the Arrow TSA.

These are chosen as examples of what is taking place throughout British Columbia. Much of the same and other practices are being followed in specific wildlife habitat management through close cooperation of the field staffs of the two ministries involved—Environment and Forests. Of course, the forest and ranching industries in the long run must also be equally committed to the multiple resource use concept.

It is important that I note advances made in recent years in cooperative research projects undertaken by the Ministry of Forests in cooperation with the Ministry of Environment and others. A major example of this work is the project entitled "INTEGRATION OF WILDLIFE AND INTENSIVE FOREST RESEARCH". Information on this and other similar projects is available from the Ministries of Forests or Environment.

Through this paper, I have attempted to outline a positive picture of participation, undertaken not only because of legislation and policy but also because of commitment by field staffs to manage our resources for the greatest ultimate benefit to all. I believe it was once assumed that good single-use forestry practices would lead to that goal. But it has become most evident in the last 10 to 15 years that the "participation" factor is an essential element required to do the job.

MIGRATORY BIRD HABITAT PRESERVATION IN BRITISH COLUMBIA AND THE YUKON TERRITORY

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INTRODUCTION

The Canada Wildlife Service (CWS) is an agency of the federal government charged with the responsibility of acting in wildlife matters of national interest. The paramount wildlife matter of national interest is management of the welfare of migratory birds according to an international treaty between Canada and the United States. The Migratory Bird Treaty of 1917 was a response to the then rapidly dwindling numbers of birds that migrated between Canada and the United States. The belief that overhunting was the cause of the decline shows in the tenor of the documents and was also borne out in reality as bird numbers rapidly rebounded once strict control of their take was promulgated in the Migratory Birds Regulations. In addition, the Migratory Birds Covention (MBC) Act allowed for the appointment of migratory bird officers who were the original appointees to the office now known as the Canadian Wildlife Service. Migratory bird sanctuaries were also established according to the act to provide year-round refuges from disturbance. The notion that the security of bird populations is primarily dependent on the availability of suitable living space, however, did not figure significantly until the myth of superabundance was permanently shattered in the intervening years. The environmental awakening of the last 30 years showed its effect in government programs as well.

A call for an organized approach in resource management by the prime minister of Canada in 1958 gave rise to the 1961 Resources For Tomorrow Conference, a section of which identified the need for federal legislation to acquire wildlife habitat. As a result, a draft wildlife policy was formulated and widely circulated between representatives of federal and provincial governments and conservation organizations. After much discussion the document was tabled in the House of Commons in 1966 by the responsible federal minister as "Canada's National Wildlife Policy and Program". Federal acquisition of wildlife habitat began shortly after in 1968 with the creation of the first national wildlife areas utilizing the provision of the MBC Act and the Financial Administration Act.

Thinking on habitat conservation matured in the meantime to embrace the needs of all species of migratory birds from the federal viewpoint and all nondomesticated animals on a Canada-wide basis. The 1973 Canada Wildlife Act contains a very broad definition of wildlife. It enables the minister to accept administration and control of public lands for wildlife conservation and to acquire or lease lands for migratory bird habitat or other wildlife habitat with the concurrence of provinces.

HABITAT PRESERVATION APPROACHES

The dependence of all wildlife on suitable habitat is now a well-established concept in all circles. Although habitat is a complex ecological phenomenon it also can be described in the simplest of terms; it is real estate. This is the basis of the preservation problem. Most habitat areas are either privately owned where land use control rests with the owner or are public lands subject to uses often contrary to the best interest of wildlife. The maintenance of habitat quality of any given land requires management decisions that may preempt options for maximum economic gain. Therefore, habitat preservation efforts must seek to control land use or means to influence land use decisions so that wildlife habitat values are maintained. The potential loss of economic gain resulting from such activities must, therefore, be balanced in upholding or gaining values that are held in high public esteem.

The simplest means of ensuring land use control is to acquire ownership, also known as fee simple estate. But high costs associated with purchase of land raises questions on its cost effectiveness. For less cost partial right to a title, or title rights with conditions, may be acquired. Such is the case in granting life estate rights to the seller of the property, thereby minimizing social disruptions but precluding immediate and full possession.

Because of the high public profile of migratory birds and the general acceptance of their requirements, concerned citizens or groups of citizens often gift tracts of land to government agencies for which tax concessions may be given. Such concessions are normally the fair market value of the land involved. Also, purchase of land at less than market value may be carried out, tax benefit being granted for the difference in value. In all these transactions care must be taken that the lands so offered are prime wildlife habitat to ensure that value gained is equal to revenue lost.

Land use control over wildlife lands may also be acquired by transfer of title from conservation foundations and by transfer of jurisdiction from other federal agencies.

The 1973 Canada Wildlife Act provides for the minister to enter into federal-provincial agreements to undertake wildlife conservation measures such as the purchase of lands on a cost-shared basis. Such actions do provide maximum control of land use. However by amounting to acquisitions in fee simple, the total cost to the public purse may make their large-scale use prohibitively expensive.

In British Columbia a fortunate set of circumstances combined with some innovative thinking brought about the creation of the National Second Century Fund of B.C., a public foundation with a charter to acquire and retain lands of high wildlife value in the public domain. Through the fund, lands with high migratory bird value may be leased to the CWS at a nominal cost for 99 years. Lands so acquired carry the same level of protection as estates in fee simple.

Means to acquire partial control of land use include the whole range of easements and restrictive covenants, many of which have been attempted while others remain in the realm of possibilities. Although it may be most desirable, acquisition as a means of habitat protection cannot be regarded as top priority because of prohibitively high cost and other practical considerations.

In terms of recent government bureaucracy jargon the "exercise of horizontal powers" may adequately describe the various activities in which the CWS is involved and which in our opinion tend to lead toward the attainment of our objectives for habitat preservation. One such activity is participation in various land use planning and resource use planning undertakings. By this means, migratory bird habitat needs and concerns are incorporated into decisions and recommendations.

Another such activity is participation in the environmental review of various development proposals. Such reviews, formalized within Environment Canada and Fisheries and Oceans and carried out by specific interdisciplinary groups of reviewers, provide the means of making migratory bird advice more effective by coordinating such information with advice from other resource perspectives. Large-scale and important projects with federal involvement are subject to scrutiny in public hearings under the federal Environmental Assessment and Review Process. Such hearings are forums at which departmental concerns can be voiced effectively.

A most welcomed development in recent years is the general acceptance by various resource users and developers of the legitimacy and desirability of environmental factors to be part of the design process. Because of such attitudes the various levels of environmental review processes appear to be working well. Environmental referrals circulated between resource management and regulatory agencies to seek broadly based decisions have now evolved into an effective means of delivering influential advice and to accommodate concerns that would not be considered without the process.

HABITAT PRESERVATION ACTIVITIES

Activities within the Pacific and Yukon Region of the Canadian Wildlife Service related to habitat preservation objectives are varied both in kind and intensity. To give a central focus to these activities we began by drawing up a habitat preservation master plan framework for this region from the federal viewpoint. Planning for wildlife habitat preservation is an ongoing activity both nationally and regionally, and ours is related to these activities. However, a considerable effort is made to clarify our role and to determine how to best complement similar efforts by other agencies. Our plans have four component topic areas, each requiring a fair amount of scrutiny. A problem analysis is undertaken to clarify peculiarities associated with the regional scene related to the federal mandate and responsibilities. Next, evaluation criteria are developed that take into account methodologies developed elsewhere and their applicability here. These must reflect current thinking on migratory bird conservation. Concurrently, the identification of important areas continues based on criteria ranging from the traditional to those accommodating current and emerging public interests. Paths to follow by priorizing between options open to us are outlined in the plan.

Many other regional activities undertaken in the CWS, Pacific and Yukon Region while addressing many habitat-oriented objectives are also adding significantly to the pool of data available for habitat preservation. Field investigations in association with population survey projects, site-specific habitat investigations, and nationally initiated projects such as wetland designation are all yielding such information.

Much effort from the CWS regional office goes into the utilization of knowledge at hand to effect habitat-preservation objectives. The involvement within the various environmental review activities, mentioned earlier, are activities where known data are creatively applied to these objectives. The effectiveness of that involvement is difficult to measure, but we have little doubt that it is the proper thing to do. We may call that group of activities the preventive medicine of habitat preservation. At the other end of the spectrum where preventive action is too late, surgery may be required; that is habitat acquisition. Just as in medicine, a combination of both types of action is required to make an effective program of habitat preservation.

The CWS has had a habitat acquisition program since the proclamation of Canada's Wildlife Policy and Program in 1966. Varied segments of high-value habitat areas were purchased or acquired by other means all across the country. Although the program was sufficiently funded in the early years of its operation, during the last few years of fiscal austerity it was reduced to grossly inadequate levels. The present level of funding barely covers earlier commitments made under federal-provincial agreements for habitat acquisition. More recent acquisitions tended to depend entirely on resources of such groups as the National Second Century Fund of B.C. and on outright donations.

There are seven areas in B.C. managed as national wildlife areas and there are two more on the way to being created. Two other areas are now being assembled to be managed on a cooperative basis with the Province of British Columbia. For some time low-level negotiations have been under way to establish wildlife areas in the Yukon Territory. Complications related to jurisdictional questions have prevented rapid progress.

One should mention here some of the tentative steps taken in building wildlife habitat on the foreshore in the Fraser River estuary. The placement of dredged material in places where natural accretion is accelerated and where fisheries habitat is not unduly damaged is now being attempted cooperatively by CWS, the Department of Fisheries, and Oceans and Public Works Canada. Building marshes on such dredged spoil is also being attempted experimentally. Should habitat building prove to be feasible, it could open a whole new chapter in compensating for environmental damage. Unfortunately, not enough is currently being done to determine the feasibility of this strategy and to work out methodologies for its application in the foreseeable future.

HABITAT PRESERVATION POSSIBILITIES IN THE FUTURE

I hope that I managed to leave you with the feeling that habitat preservation is a high priority with the CWS and that outright acquisition, although regarded as an indispensable measure, is not the only means to that end. We are attempting to do the most within constraints that are imposed on us by current fiscal realities and to take advantage of opportunities as they arise.

Efforts are currently underway within Environment Canada to re-establish the former funding level of the habitat acquisition program. We are not without hope that this initiative will be successful.

A further initiative that has great potential on habitat preservation is a wetland identification and designation program. With provincial cooperation, its eventual aim will be to avoid inadvertent habitat destruction and impairment by developments that are fully or partially supported by government.

I would like to leave with you news about perhaps the most promising federal effort in habitat preservation in recent years. Establishment of a trust fund, not accidentally to be called Habitat Canada, is now being considered. Proceeds of the fund would be used for habitat acquisition both to set aside important habitat and to set up areas attractive to wildfowl to prevent their concentration on, and depredation of, neighboring farming areas. Should this effort prove successful, we would be in a much better position to complement our work in other aspects of habitat preservation and to cooperate with other agencies working toward these common objectives.

THE RACE FOR SPACE

EVOLUTION OF WILDLIFE HABITAT EVALUATION AND MITIGATION PRACTICES USED BY B.C. HYDRO

R.M. BRADLEY

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In the early 1970's, environmental involvement dealt primarily with input to the planning of new generation projects. As the state-of-the-art improved, environmental and socioeconomic functions grew to include monitoring of construction, solving operational problems, and involvement in planning, constructing, and operating transmission lines. At present Environmental and Socio-Economic Services Department (ESS) consists of about 40 people in sections dealing with terrestrial ecology, aquatic ecology, air and water quality, socioeconomic studies, and program coordination. ESS, while in the Engineering Group, has a cross-corporate consultative role.

As B.C. Hydro endeavored to keep pace with increased awareness of environmental values, predevelopment wildlife studies grew in complexity. Whereas studies on G.M. Shrum and Mica were only aerial overviews during or after flooding, studies for the Seven Mile Project involved some on-ground deer censuses and a subjective habitat evaluation. Revelstoke studies, prior to development, were only slightly more advanced than those for Seven Mile but considerable inventory work has continued during construction. Studies of the proposed Site C project have included more intensive aerial surveys of aquatic furbearers, ungulates, and waterfowl and on-ground studies of these species groups plus terrestrial furbearers, small mammals, and passerine birds. The current ecological studies on the Liard and Stikine-Iskut river systems are probably the most comprehensive project-oriented wildlife studies done in B.C. Aerial surveys, habitat quality, browse utilization and pellet distribution are used to estimate existing population levels, habitat selection, and preference, and capability for population growth. Field crews gather the data needed to meet the habitat quality objective and secondary sightings or observations are recorded to add to the environmental data base. All data gathered are being formatted for computer storage and handling. B.C. Hydro is presently doing pilot studies on the use of an interactive computer-assisted mapping and geographical information system (ICAM-GIS). This system is designed to handle large volumes of geographically related data and allows easy interaction and map-scale manipulation of maps showing forest cover, vegetation types, habitat quality, wildlife distribution, construction sites, and so on.

Only a short time ago consideration of mitigation or compensation for project impacts on the environment were nonexistent. Present wildlife mitigation considerations influence design and construction options and techniques, reservoir-clearing methods, monitoring programs, and habitat-improvement proposals.

Approaches to the mitigation of wildlife impacts of transmission lines have undergone considerable change in the past few years. Lines which are planned and constructed with consideration of wildlife values can benefit wildlife. Selection of a route option which skirts critical winter range can avoid direct adverse impacts. The adverse effects of poorly planned access roads can be avoided by early consideration of wildlife values by judicious use of helicopter construction of towers, by the design of multipurpose roads, and in some cases by the reclamation and closing of access roads. The involvement of environmental officers to monitor transmission-line construction has begun with the Northeast Coal Project and is proposed for the Cranbrook/Alberta Border line. The terms of reference for these officers include writing of environmental conditions in contract specifications, review of clearing standards and their application, and inspection of construction sites for violation of environmental requirements. Examples of construction activities that can be regarded as beneficial to wildlife are: helicopter assembly of towers, double circuiting to reduce right-of-way widths, revegetation of rights-of-ways, and selective clearing.

Reservoir clearing standards have changed greatly with time. All of us have seen reservoirs where the timber was left standing and the floating debris was permitted to accumulate. On some reservoirs there have been expensive debris removal programs, occasionally in conjunction with a timber salvage objective. Valid criticism of this debris accumulation and removal practice has been voiced regarding hazard to boating, loss of scenic qualities, and wasted forest resources. However, one's reaction to this situation can lead to excessive machine-clearing of all woody material. If this happens, a highly erodible shoreline with no vegetation results. Clearing policy for the Seven Mile and Revelstoke projects have included input from staff and government biologists and provision for wildlife oriented leave-strips along streams, on sensitive soils, in important migration corridors or feeding habitats, and in special impact-monitoring plots.

Monitoring of construction impacts and habitat improvement after construction commenced on the Seven Mile Project with the hiring of an on-site biologist. Impact monitoring included a continuation of nocturnal "eye" counts of white-tailed deer and pellet group surveys to provide an index of seasonal abundance and habitat selection. Radio-tracking provided more precise data on deer ecology in the Pend D'Oreille valley and added valuable information on summer distribution of deer which depend on the winter range in that valley. A key element of the mitigation for deer losses has been the acquisition by the Fish and Wildlife Branch of properties found to be crucial in the winter survival of the remaining deer. This land acquisition program gives the branch management authority to achieve an optimal mix-ratio of feeding and shelter areas for deer. Vegetation manipulation on these lands already incorporates controlled burning, debris clearing, brush cutting, and reclamation and reforestation.

The success of the Seven Mile resident-biologist program has been motivation for a similar but more detailed program at Revelstoke, which is still in the impact monitoring stage. B.C. Hydro biologists and the Fish and Wildlife Branch are cooperating in the conduct of the following interlocking and mutually beneficial studies:

Fish and Wildlife Branch

- systematic monitoring of radio-collared moose to determine relative use of habitats adjacent to the reservoir
- placing radio-collars on grizzly bears and visual collars on black bears to determine movements and habitat selection
- radio-tracking caribou to determine migration routes and habitat utilization
- reviewing logging operations and folio plans
- monitoring hunter use of the Revelstoke valley.

B.C. Hydro

- assessing habitat utilization of moose by browse and pellet-group transects, intensive winter tracking and recording of food habits, and annual aerial surveys of winter distribution
- beaver tagging and aerial surveys of food caches to determine survival and behavioural response to reservoir clearing and flooding
- daily ground surveys of waterfowl during spring migration, weekly surveys during fall migration, and annual aerial surveys to assess migration timing, nesting success, and relative habitat use
- winter track surveys of terrestrial furbearers to determine relative densities and habitat utilization

- scent-station surveys for bear to determine relative densities in different habitat types
- collection and analysis of bear scats to assess seasonal food habits
- small-mammal trapping to determine species diversity and relative densities
- assembling of all sightings of avian species
- snow-stake surveys to relate snow depth to habitat type, slope, aspect, elevation, and moose use
- computer assimilation of data.

The summary and conclusion of this brief history of habitat evaluation and mitigation procedures in B.C. Hydro is best stated in a quotation from an anonymous author:

> What was, was; what is, is; and what is to be, is what we make it.

WILDLIFE MANAGEMENT AND LAND USE:
"HOW ARE WE FARING IN THE RACE FOR SPACE?"

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I welcome the opportunity to participate in this forum. The background, experience, and views of the participants are certain to produce some hard headed analysis of problems and opportunities for wildlife. Other such forums in which the Fish and Wildlife Branch of the Ministry of Environment has participated, have yielded constructive criticism of our programs and presented options for future action. I believe that this conference will do no less.

The race for space is a catchy title for the panel and my task is to take a look at what is going on and try to assess how well wildlife habitat is faring, and make a few observations on the future. I cannot cover the habitat needs for the 600-plus species of wildlife, indeed for many species we do not know what is required. Nor can I deal with all the complex habitat types found in the province. So I intend to review two broad approaches that are providing opportunities to benefit wildlife.

The first approach is by acquisition, gift, transfer from Lands, Parks and Housing, or any process which gives the Ministry of Environment primary management rights to the land. The second approach is through co-management processes, such as Coordinated Resource Management Planning (CRMP) or a variety of forest management planning processes in which we share the land base with other resource users. I chose these two approaches for their contrast. Acquisition is current, clear cut, tangible, simple, and is satisfying. But co-management is long-term, cooperative, complex, requires compromise, and is frustrating.

We have been acquiring management rights to land since the early 1950's, and to date we have about 0.86-million hectares under a variety of tenures. Approximately 0.37-million hectares are held under secure tenure, such as Order in Council reserves, greenbelt land, outright purchase, long-term lease, and consignment from private organizations such as the National Second Century Fund. The remaining 0.49-million hectares are held under less-secure tenures, such as map reserves and notations of interest. However, it is the quality of such lands that is important, as some kinds of habitat are more critical or more useful than others. Of the 0.86-million hectares under various tenures, 35,230 hectares are marine, intertidal, or estuaries, 25,884 hectares are freshwater wetlands, 358 hectares are terrestrial bird habitat, and 17,454 hectares are mixed habitat types, mainly riparian or land-water interfaces. Such areas are high quality and the amount of such land in the province is limited. The remaining 0.78-million hectares are classed as ungulate range and while some of it is of high quality, much of it is similar to other large tracts of crown land.

The acquisition of key parcels of land either by purchase, lease or consignment of crown land continues and is the best way to acquire full management rights. Such lands are usually acquired for a specific purpose. Examples are sanctuaries, such as the Bergenham property near Golden in excess of 400 hectares. We also have greenbelt consignments, either completed or pending amounting to 3,360 hectares in a dozen sites scattered throughout the province. Recently, we have used the Land Act (Section 101) to have areas transferred to our ministry and with the assistance of the Ministry of Lands, Parks and Housing, we will continue to do this. Over the past 20 years, we have bought approximately 4,600 hectares, not counting recent acquisitions under the Habitat Conservation Fund, and these areas include many quality pieces of habitat, such as the 316 hectares of California bighorn sheep winter range in the Ashnola. The National Second Century Fund of British Columbia has purchased and leased to us at least 25 extremely valuable habitats. One of these parcels is only one quarter of a hectare while others, such as Chilanko Marsh (Cariboo) and Addington Marsh (Lower Mainland) are in the 200-250 hectare range. Each is a superlative addition to the wildlife heritage of the province. Each supplies a necessary ingredient, making the overall picture more complete. Estuaries, marshes, and riparian habitat are habitat types very commonly selected by the National Second Century Fund of British Columbia with our full support and assistance. We need these kinds of environments, and often the only way to acquire management rights to them is by acquisition. I want, at this time, to publicly acknowledge the magnificent work done by the National Second Century Fund of British Columbia in acquiring key pieces in the mosaic of wildlife habitat.

Very recently, we have been acquiring land by use of the Habitat Conservation Fund to the extent of $1.25 million per year. Twelve parcels of land have either been acquired or are pending and over the next 10 years we will acquire a further 50-60 sites using this method. All properties for which we have primary or sole management rights are shown in table 1.

Some examples of specific site acquisitions follow.

Critical habitat for a rare and endangered species

MacMillan Bloedel has donated about 200 hectares of Vancouver Island marmot habitat. Incidentally, our latest field work shows a healthy increase in the number of marmots and in the number of colony sites.

TABLE 1. Designated Wildlife Lands by Type of Tenure

Resource region	HECTARAGE BY TYPE OF TENURE									
	Designations Under Land Act									
	Section 101 transfer[a]	Order in council[b]	Map reserve[b]	Notations of interest[b]	Greenbelt Act[c]	Branch purchases to 81	Habitat conservation fund[d]	Lease	Other[e]	Hectarage by region
Vancouver Island	-	1,441	2,351	2,651	73	0	-	292	16	6,824
Lower Mainland	-	10,811	229	26,082	1,252	0	55	333	105	38,867
Thompson-Okanagan	-	23,306	6,560	4,033	113	360	581	0	1,337	36,290
Kootenay	114	333,282	82,310	96,256	1,714	1,633	365	720	0	516,364
Cariboo	5,823	0	11,357	13,160	123	0	-	202	0	30,667
Skeena	-	0	7,735	1,501	49	0	-	52	615	9,953
Omineca-Peace	227	176	243,971	0	0	0	361	76	0	244,811
Hectarage by type of tenure	6,163	369,015	354,514	143,682	3,324	1,993	1,362	1,647	2,074	883,775

[a] Transfer of administration and control of crown land to another government agency.
[b] Legally map reserve and notation of interest are the same but the map reserve offers stronger protection.
[c] Intent only, not all consigned to environment.
[d] Proposals in progress or in negotiation stage.
[e] Consignment from another government agency, crown corporation, or private source.

Spawning channel

Thanks to the National Second Century Fund of British Columbia and the Habitat Conservation Fund, a 3.2-hectare site has been obtained on Redfish Creek on Kootenay Lake, upon which to build a spawning channel for kokanee.

Marsh land

Again, the National Second Century Fund of British Columbia enabled us to secure a 22-hectare waterfowl area at Nanaimo, known as Buttertubs Marsh. Developed in association with Ducks Unlimited (Canada) and supported by the city and local education authorities, it is an example of bringing wildlife into the city.

Big game winter range

The Junction Wildlife Management area in excess of 5840 hectares has been transferred to the Ministry of Environment by the Ministry of Lands, Parks and Housing. This area contains one of the largest California bighorn sheep herds in the world, and is becoming increasingly famous as a natural grassland ecosystem.

I have stressed the good work being done to retrieve key parcels of private land and to obtain primary management rights on selected crown land through the Ministry of Lands, Parks and Housing. But, if the fate of wildlife is dependent upon these areas alone, it would not be enough. Important as specific sites are, it is on the much larger area of crown land and private land that the future of the 600-plus species is dependent. This brings me to the second approach to obtain habitat space for wildlife—comanagement.

The Ministry of Environment is working with Ministry of Forests, Ministry of Lands, Parks and Housing, and with the Coordinated Resource Management Planning (CRMP) process to bring about comanagement of the land. You have heard from the Ministry of Forests and the Ministry of Lands, Parks and Housing earlier in this seminar about their land planning activities. But I am going to emphasize a few numbers to show the scale of events--events in which we must participate if wildlife is to be fairly treated.

The Ministry of Forests has 60.3-million hectares in public sustained yield areas and there is 8.8-million hectares in various kinds of private forest tenure, and a further 10.4-million hectares of rangeland. The annual cut is taken from an average of 120,000 hectares, and another 66,000 hectares are burned. Over a 10-year period, these annual figures add very quickly. Indeed, anyway you look at it the numbers associated with the Ministry of Forests are large. What the Ministry of Forests does on the forest and rangelands to a substantial degree, determines the number and variety of species found over much of British Columbia. I doubt I have to document this interaction to this forum.

Their recent program to establish provincial forests is a big plus for wildlife, as it establishes a reasonably firm land tenure upon which to plan. Without such a base, long-term planning for wildlife is not practical.

The new Forest Act, with its emphasis on producing a mix of benefits from forest land through an open planning process, provides opportunities to benefit wildlife and we are trying to utilize these opportunities. I am not saying everything is ideal, but I am saying the Ministry of Forests' emphasis on securing a stable land base and managing the resources of this land through a co-management approach can be of great benefit to wildlife.

The Ministry of Lands, Parks and Housing is rapidly implementing a land use decision-making process. In its own way, it will be an equally valuable opportunity to benefit wildlife. While the area is not as large, they are generally of higher quality in terms of biological productivity. We expect to benefit by having some high-quality wildlife land turned over to the Ministry of Environment. Indeed, this process has already started.

Finally, I must acknowledge the contribution of the Coordinated Resource Management Planning (CRMP) process to wildlife. This process is designed to reduce conflict and increase benefits from the multiple use of crown lands. Currently, there are 86 Coordinated Resource Management Planning (CRMP) projects totalling in excess of 0.57-million hectares, mainly in the southern part of the province. Their emphasis on better land practices, reducing erosion, and increasing forage production will benefit many species of wildlife.

In summary, the retrieval of private land has increased rapidly over the past decade in response to demonstrated need, such as habitat for endangered species, land to meet special requirements, wintering or nesting grounds, and habitat to round out current holdings. Purchases and lease back by the National Second Century Fund of British Columbia, gifts from citizens and companies, transfer of land from other ministries, especially Ministry of Lands, Parks and Housing and acquisitions by Ministry of Environment are providing specific habitat sites required to protect and manage wildlife. And, complementary to these acquisitions, there are several province-wide resource planning processes to bring about co-management. In particular, the Ministry of Forests and Ministry of Lands, Parks and Housing are implementing management processes that provide increased opportunity for protecting and managing wildlife habitat.

A big challenge of the 80's is to continue the acquisition of land for specific management needs using methods which appear secure at this time. But our biggest challenge is to implement our wildlife plans--provincial, species, regional, and site-specific--within the ambit of those agencies responsible for land and habitat use in the province. And to meet these challenges, all people who are concerned about the future of wildlife must become directly involved.

THE NATIONAL SECOND CENTURY FUND OF B.C.: A GROWING GIFT

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All of us here today recognize the need to protect the integrity and stability of our natural environment. Our chief interests may vary--soils, plants, birds, insects. But taken together, the protection of all components in a balanced system is necessary for the good health of every living thing.

To preserve ecosystems we must control the land base. Public control of land use in Canada is the responsibility of the provinces which delegate regulatory powers to various bodies such as crown ministers, municipalities, and regional districts. The federal government has only limited power to regulate land use and it arises indirectly through the exercise of other powers. Indian lands are an exception; they are owned by the federal government for the benefit of Indians with certain rights on them available to the provinces. "Fee-simple" lands, or privately-owned lands, include all rights and therefore control everything in, on, or over the lands subject to certain provincial powers.

Control of the land base can basically be achieved in two ways. Legislation can be applied to public or private lands and full or partial interests in private lands can be acquired.

Direct Legislation

Lands may be reserved for wildlife and other uses through the application of protective statutes to public lands. For example, the provincial, national, and regional parks acts, the Ecological Reserves Act, the Agricultural Lands Commission Act, the Canada Wildlife Act, or the Heritage Conservation Act are all useful. Of these, however, only the Ecological Reserves Act is concerned exclusively with ecosystem preservation. Other protective statutes may allow uses of the land which are inconsistent with preservation of certain species. Another disadvantage of this method of reserving lands is the amount of time required to establish the area and the uncertainty of long-term protection caused by changing government policies and control.

Indirect Legislation

Legislation can indirectly preserve lands for wildlife through zoning, regional and community plans, and subdivision control. Sympathetic urban planning can be of great benefit encouraging the establishment of hedgerow and backyard wildlife areas. Alienation of large parcels is unlikely, however, because of the cost of maintaining them and lost tax revenue. And long-term protection is uncertain as pressures on urban space increase.

Full or Partial Land Acquisition

The best way of controlling the use of lands is to own the full interests in those lands. Lands may be acquired through purchase, gift, trade, and by the government through expropriation. Fee-simple ownership involves the conveyance of all rights including the right to alienate the land and the right to everything on, over, and in the lands. In most cases in British Columbia landowners do not own mineral rights or the beds of rivers or lakes although old crown grants still exist where these interests are attached to the title.

Partial interests in land may also be acquired and it may not, in all cases, be necessary to have all the rights associated with the land to control its use for wildlife. Restrictive covenants, legal easements, and right-of-ways are charges which may be applied to a title at the owner's consent. They are charges which run with the land. That is, if the land is sold, the charges remain in effect even though the ownership has changed. In Canada, easements and right-of-ways must have a dominant and servient tenement, that is the right enjoyed on the land must benefit adjacent lands, and the dominant and servient tenements must have different owners.

In the U.S.A., conservation easements can be charged against lands by the government or a conservation organization like the Nature Conservancy. Conservation easements are negative rights restricting the right of the landowner to develop or use his property. For instance, a landowner could convey his rights to harvest timber, subdivide, construct roads or buildings, hunt, or graze the property. By conveying these rights, the property assumes a lower market value and the landowner's tax assessment and taxes are decreased. The only disadvantage to this method of protection is the difficulty in policing the easement. At present, we cannot establish conservation easements in Canada because of inhibiting legislation.

Restrictive covenants, which can be used similarly to conservation easements, can be charged in favor of government agencies without the existence of a dominant tenement. Otherwise, the rules which apply to the use of right-of-ways and easements apply to restrictive covenants. Once again, enforcability of the charge can be a problem where landowners are not sympathetic to the intended land use.

Another partial interest that can be held to protect lands is a lease. Leases convey exclusive possession for a period of time. The disadvantage to the method, of course, is its impermanence.

Of the different means of controlling lands in British Columbia to protect ecosystems—legislation, direct and indirect, and acquisition of full and partial interests--it is clear that the strongest protection is afforded through acquisition of full interests. Preferably this should be undertaken by a group whose sole charitable purpose is to establish nature reserves. With this in mind, the National Second Century Fund of B.C. was formed. The fund is a private, nonprofit, charitable organisation established in 1971 to acquire lands in this province for the "preservation of areas, species and objects of significant ecological interest". It was created out of the recognition of the need to control privately-held lands specifically for the flora and fauna dependent on them, for the perpetuation of species, and the education of future generations.

$4.5 million was given by the federal government to establish the fund and the interest is used, with donations, to purchase full ownership in fee-simple lands. Upon acquiring the lands, they are leased to management group under a 99-year lease agreement at a cost of $1.00. The manager assumes all responsibilities of cost and stewardship. In a few instances, the fund has arranged for a lease with a sublease to a local interest group. This works very well with continuity supplied by the lessee and enthusiasm provided by the sublessee. All leases allow the fund the right of re-entry and forfeiture of the lease upon nonperformance of covenants contained within it. The lease specifies that the area is to "be preserved as an area of ecological interest".

Proposals arrive at the fund from a variety of sources: the Fish and Wildlife Branch, the Canadian Wildlife Service, the Federation of B.C. Naturalists, Regional Districts, local clubs, and landowners themselves. Lands are evaluated based on their degree of diversity, freedom from human disturbance, ability to be protected, and relative importance and uniqueness related to their local, regional, and national significance. Preservation of endangered, threatened, and peripheral species as well as sensitive and threatened ecosystems such as estuaries receive a high priority. In the 10 years since its formation the fund has acquired over 3000 ha in 61 properties throughout the province (fig. 1). Perhaps the best way to describe what the fund does is to discuss some of our projects.

Fund Projects

Vancouver Island. The fund has, to date, acquired 230 ha of land for wildlife on the island. Nanoose Bay National Wildlife Area is leased by the Canadian Wildlife Service. It consists of 32 ha of cultivated fields, riparian woods, and estuary flats; 14 ha are regularly inundated by tides and 2 creeks, Nanoose and Bonnell, which snake across the property to open up into Nanoose Bay. 190 species of

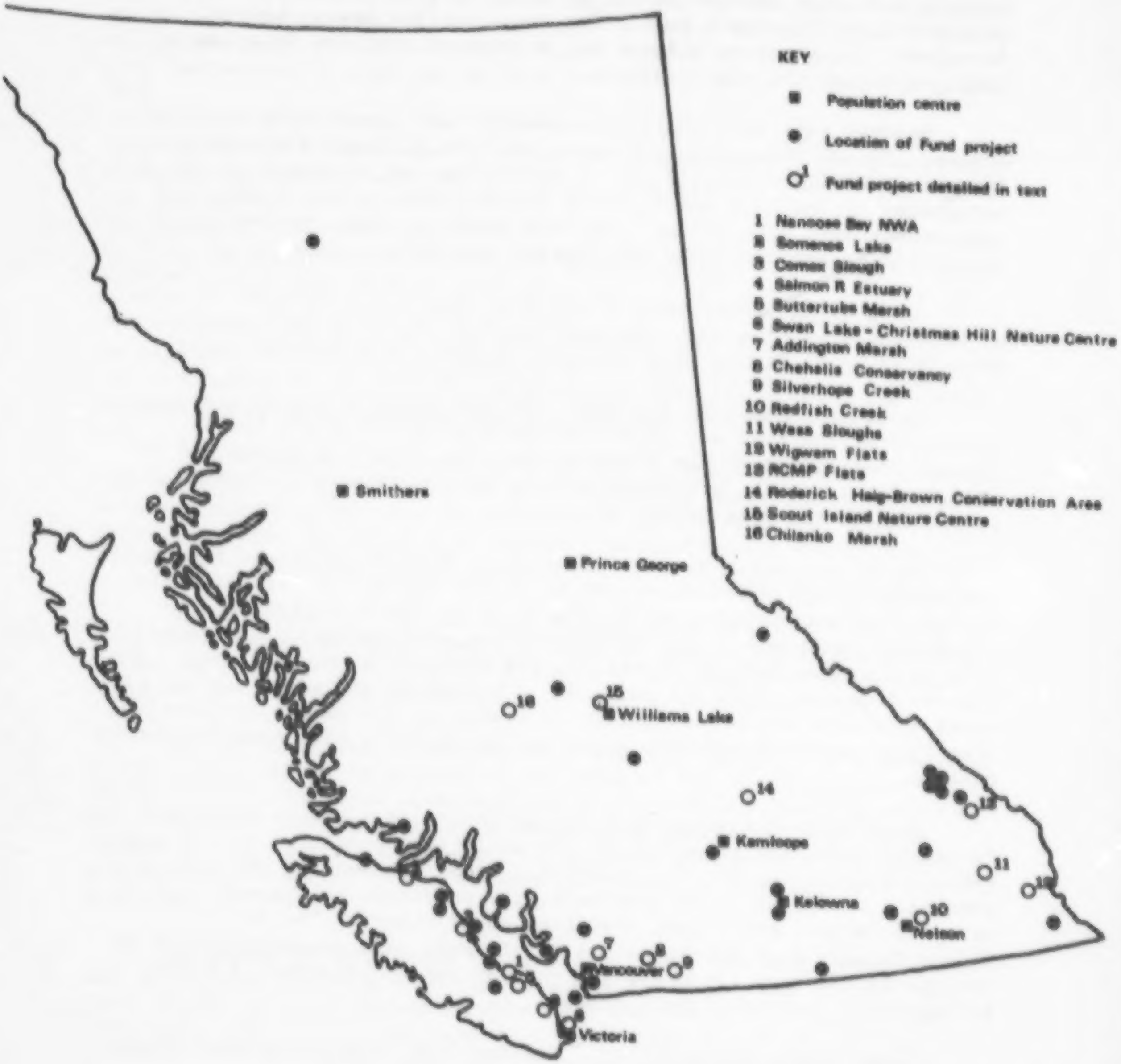
KEY
■ Population centre
● Location of Fund project
○¹ Fund project detailed in text
1 Nanoose Bay NWA
2 Somenos Lake
3 Comox Slough
4 Salmon R Estuary
5 Buttertubs Marsh
6 Swan Lake - Christmas Hill Nature Centre
7 Addington Marsh
8 Chehalis Conservancy
9 Silverhope Creek
10 Redfish Creek
11 Wasa Sloughs
12 Wigwam Flats
13 RCMP Flats
14 Roderick Haig-Brown Conservation Area
15 Scout Island Nature Centre
16 Chilanko Marsh
Smithers
Prince George
Williams Lake
Kamloops
Kelowna
Nelson
Vancouver
Victoria
1
2
7
8
9
10
11
12
13
14
15
16

Figure 1. Location of 16 of the 61 properties acquired by the National Second Century Fund of B.C.

animals have been counted on the wildlife area including the winter wren and coast blacktail deer. The area receives heavy seasonal use by waterfowl; 700 American widgeon may be seen at one time foraging at tideline during the winter months.

Somenos Lake is a shallow freshwater lake immediately north of Duncan. It and Quamichan Lake empty into the Cowichan River immediately east of Cowichan Bay. 22 ha of waterfront was purchased by the fund and leased to the Fish and Wildlife Branch. Hay is cut on the land each summer and, come winter, the lake rises flooding the cut fields and providing habitat for ducks, geese, and swans.

Comox Slough forms part of the Courtenay River Estuary. 0.4 ha of land and 4 ha of slough were purchased by the fund and leased to the Comox Strathcona Natural History Society for a wildlife sanctuary.

36 ha of floodplain and forest on the Salmon River Estuary were purchased by the fund and leased to the Fish and Wildlife Branch. Sloughs course through the property and they, with the meadow and upland decidous growth, provide a variety of habitats as well as lending protection to the rest of the estuary.

Buttertubs Marsh is a 17 ha marsh in Nanaimo purchased from under the wheels of the developers. It is leased to the Fish and Wildlife Branch. To improve management options on it, Ducks Unlimited constructed islands and a water-control structure, opened up the vegetation to increase habitat diversity, and repaired a crumpled dyke. The broods of Canada geese and mallards, a beaver lodge, and a variety of marsh creatures are enthusiastically tended by the senior citizens who live in a complex beside the marsh and by families that come for Sunday strolls.

Swan Lake--Christmas Hill Nature Centre is a nature education facility in Saanich supported by the municipality and run by a society specifically set up for that purpose. Lands surrounding the lake were purchased with funds from greenbelt, the province, the Nature Conservancy of Canada, and school districts among others. The National Second Century Fund purchased 2.4 ha of land. The accomplishments of the centre are many including its popular school programs, a self-guided trail, and wheelchair access.

Lower Fraser River Valley. Despite high property values in the lower Fraser Valley, the fund has been able to purchase 680 ha of sensitive lands.

Addington Marsh is located on the Pitt River across from the Pitt Wildlife Management Area. It consists of 263 ha of dyked marshland and is leased to the Fish and Wildlife Branch. It is closed to hunting, a condition of sale, and forms a valuable part of the Pitt River wetlands.

Another wetland area of great importance is the Chehalis Conservancy. 202 ha in size, it encompasses the mouth of the Chehalis River, the marshy area of the delta, and lower reaches of the river. This area has unusually high use by bald and golden eagles during the salmon run.

Across the Fraser and near Hope is the Silverhope Creek project. 90 ha were purchased adjacent to Silver Lake Park to protect the creek and its summer run of steelhead and the southerly portion of the lake. The property surrounds the creek for about one kilometer and stretches up into the surrounding sharply rising mountains. Goats are usually sighted in the mountains.

The Kootenays. The fund has purchased over 950 ha of ecologically significant lands in the Kootenays. At Redfish Creek near Nelson, 3 ha were bought on the floodplain of one of only three remaining viable kokanee spawning streams which empty into West Arm of Kootenay Lake.

Wasa Sloughs, a joint project of the Nature Conservancy of Canada and the fund, is a shallow lake in the Kootenay River valley near Fort Steele which provides diverse habitat for migratory birds, particularly Whistling swans and Great Blue herons. Located beside the highway, it also serves as an educational area.

8 ha of land was purchased at Wigwam Flats south of Elko to protect a population of Rocky Mountain Bighorn Sheep. This area has been leased to the Fish and Wildlife Branch and it, with additional lands acquired or reserved by the branch, forms the management area.

The National Second Century Fund has been working for a number of years to acquire and preserve the wetlands of the Columbia River valley. Over 690 ha of marshland has been purchased from Edgewater to Spillimacheen including 230 ha of land known locally as RCMP Flats bought by the fund and the Nature Conservancy of Canada. The fund has a continuing interest in the marshes and places a high priority on their protection.

The Roderick Haig-Brown Conservation Area, the protective corridor which runs the length of the famous Adams River, was a joint project of the National Second Century Fund and the Parks Branch. The fund spent $500,000 to purchase 41.4 ha of land within the 977 ha corridor, 35% of the private lands acquired. The quality of the river, and therefore its productivity particularly for sockeye salmon, was being threatened by encroaching development. Establishment of the park and inclusion of the private lands bought by the fund has ensured the long-term protection of this great river.

At Williams Lake, Scout Island Nature Centre has assumed an important role in the community. A nature house with displays and programs is located on one of three islands at the western end of Williams Lake, all three purchased by the National Second Century Fund.

The center is ably run by the Williams Lake Field Naturalists and attracted over 7,500 people to its programs last year.

About 160 kilometers west of Williams Lake in the Chilcotin Plateau Region and at the junction of Tatla Lake Creek and the Chilanko River lies a shallow floodplain area, Chilanko Marsh. The marsh is contained within an historic ranch which had been unsuccessfully ditched and drained by the owner for agriculture. The fund purchased the deeded portion of the ranch including three heritage buildings and leased it to the Fish and Wildlife Branch. This area with the crown lands form a management unit of over 400 ha. Ducks Unlimited, in conjunction with the Fish and Wildlife Branch, is working on the marsh carrying out long-term inventories and restoring the marsh to its historic state.

The Future

The National Second Century Fund is growing. Each year the list of completed projects increases and land is added to established projects. By cooperating with other groups--the Nature Conservancy of Canada, Ducks Unlimited, and the Ministry of Environment Habitat Conservation Fund--the number, size, and type of project in which we can participate are growing. This year, the fund has completed 3 new projects and added to 2 others. We expect to complete at least 3 more projects before January.

The Second Century Fund's program works. It is a small, private organization, eight directors from around the province make the decisions, and the money to purchase lands is immediately available. As such, significant properties can be bought as soon as they come up for sale, or even before, and, because it is private, a change in government cannot change the fund.

Once property is purchased, it remains in the ownership of the National Second Century Fund. All rights afforded a private landowner also belong to the fund, and, therefore, the fund controls the use of lands it owns. Ninetynine-year leases are subsequently drawn up providing a double safeguard that the property will be used as a site of ecological interest. Any other use is secondary and must be approved by the fund and the lessee.

As property prices go up, we must look at other ways to control lands such as acquiring partial interests in land. The successful use of restrictive covenants, conservation easements, and right-of-ways by the fund would require a change in legislation as has been done in the U.S.A. Improved tax incentives, both on capital gains, gift, and property taxes, would increase our ability to preserve lands for wildlife.

The National Second Century Fund is a growing gift. Its funds are perpetual and are added to every year. The variety of its projects and land base are growing and the number of people and groups with which it cooperates are growing. And as the pressure for land increases, so grows its responsibility.

But most important of all, on those small pockets of land already set aside by the fund, the Ministry of Environment, Ecological Reserves, or the Nature Conservancy of Canada, flora and fauna continue to grow. And with it grows the chance that our children will experience the diversity and beauty of our natural environment as we know it and as others knew it before us.

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THE ROLE OF DUCKS UNLIMITED IN WATERFOWL HABITAT PRESERVATION IN B.C.

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Ducks Unlimited is an international nonprofit conservation organization dedicated to the perpetuation and increase in North America's waterfowl resource. It is divided into three associated organizations: Ducks Unlimited, Incorporated, the U.S. company; Ducks Unlimited, Canada; and DU Mac, Ducks Unlimited, Mexico.

The concerns leading to the formation of this unique company began early in the first quarter of this century. The consensus among waterfowlers and U.S. government wildlife authorities at that time was that there was a general and continuing decline in waterfowl numbers. A study carried out in the late 1920's and early 1930's confirmed this. It pointed out that over 65% of North America's waterfowl are totally dependent on breeding areas in Canada. Furthermore, these breeding areas were rapidly disappearing, mainly because of agricultural drainage and cultivation programs. These wetland losses, coupled with severe droughts, such as was occurring at the time, created drastic declines in waterfowl production. The basic conclusion of the study was that if waterfowl populations were to be restored and maintained it was imperative that a program begin immediately to rehabilitate and restore waterfowl breeding habitat in Canada. At this time it was recognized that it was beyond the legislative authority of the U.S. Fish and Wildlife Department to provide any funds for this program since it was outside the United States borders. Also, there were no indications in Canada that either the federal or provincial governments were prepared to undertake such a program. Therefore, in January 1937, a nonprofit organization entitled Ducks Unlimited, Incorporated was formed with the objective of raising the funds necessary to develop and restore waterfowl habitat in Canada. In 1938 sufficient funds had been raised that a sister operational body entitled Ducks Unlimited, Canada was formed. Its purpose was to use these funds to carry out this task. Since this humble beginning approximately 43-years ago, Ducks Unlimited has invested over $100 million in more than 1800 waterfowl projects encompassing over 3.5-million acres of habitat across Canada.

Right from the beginning it was recognized that an enormous amount of funds would be required. Therefore in order to obtain the most benefit from the funds raised, a policy was set that Ducks Unlimited would not own, buy, or lease any land involved on their projects. It would operate on a free easement system; that is, the land required would be donated to Ducks Unlimited. Ownership of the land would remain with the titleholder for private land and with one of the respective governments for crown land. In following this policy Ducks Unlimited recognized that even though their objective was to secure and develop areas for waterfowl, their proposals whenever possible must incorporate other benefits in order to obtain the co-operation of the landowner. When the land was crown, possible benefits to other wildlife and to fish would be considered. On private land, most of which is used for agricultural purposes, it became necessary to identify potential benefits for ranching or farming and incorporate these into the development plan. However, the main purpose for all development must remain waterfowl oriented.

This approach has proven to be very successful. It has been estimated that the dollar value of land donated for Ducks Unlimited's program exceeds $200 million. From the landowner's perspective the agricultural benefits have been significant. The private landowner has obtained works which have improved the economics of his agricultural operation. The crown has been given the opportunity to have areas secured and developed which they normally would not have been able to do themselves because of either their limited resources, the area was on private land, or because of policy constraints. Besides providing Ducks Unlimited with the obvious benefit of allowing them to use their funds to secure more for waterfowl habitat, this approach has produced two additional benefits. First it has influenced the way that many landowners now regard wetlands. Many hundreds of acres of habitat exist today, not because Ducks Unlimited or anyone else has secured them but because the landowners have recognized their value and through their own initiative ensured they were not destroyed. Secondly, it has helped those in government charged with the responsibility for the resource to make more of a case for a higher priority for wetland preservation and for having the values of wetlands incorporated into the land use planning process.

The multibenefit project and the direct involvement of the landowner and the government agencies in our program has worked very successfully in British Columbia. Ducks Unlimited began its program in British Columbia in 1968 by developing a joint Ducks Unlimited-federal-provincial project, the Creston Valley Wildlife Management Area. In the subsequent 12 years, 160 wetlands were developed covering approximately 21,000 acres.

Although, British Columbia comprises approximately 9.5% of Canada's land base, only a small percentage of this is waterfowl habitat. High-quality waterfowl habitat frequently coincides with developed, or potentially valuable agricultural land. In B.C. both agricultural and waterfowl habitat are restricted by the same factors; terrain, altitude (growing season), and availability of water. Therefore, the waterfowl habitat is not evenly distributed throughout the province but is concentrated in small pockets. These are usually in the major river valleys or on the plateaus of the south central interior and the Peace River country. As a result we have found that work on waterfowl habitat generally can be divided into 3 types: floodplain development, internal improvements to larger wetlands, and providing water security for small wetlands.

The problem associated with floodplains is seasonal water level fluctuations especially on the major rivers where the late spring flooding caused by mountain runoff affects nesting in the adjacent marshes. A very low runoff can result in reduced marsh habitat, and hence, a reduced waterfowl nesting effort. Conversely, a high flow which normally occurs well into the waterfowl nesting period floods the nests resulting in a reduction in that year's waterfowl production. The development carried out to minimize these problems is construction of dykes containing water-control structures between the marsh and the river. Then during high flows the river is prevented from flooding into the marsh and during low-flow years, the dyke retains runoff water, or in some cases, water pumped in from the river. The managed water levels result in improved marsh habitat, higher breeding populations, and greater nesting success. This type of habitat is located largely on the Columbia and Kootenay rivers in the southeast portion of the province and on the lower mainland where tides influence fluctuations.

The second type of project involves the development of the waterfowl potential of some of the larger marshes or lakes. This potential is not being reached because of the lack of suitable nesting cover, poor dispersion of aquatic cover, and lack of "loafing" sites. The current remedy for all three of these limitations is to construct islands connected by sinuous channels. Also where possible a water-control structure is placed on the outlet to legally secure the optimum water level and minimize fluctuations.

The last type making up our program involves developing the small marshes located mainly on ranching land of the interior. These are generally concentrated in groups, usually on the same water course. These comprise some of the highest quality waterfowl habitat in the province. An uncontrolled water level or an unreliable source of water along with lack of nesting cover are their biggest limiting factors to waterfowl production. The work carried out in these areas involves the construction of water diversions and controls and internal works to provide suitable nesting sites.

As previously mentioned this program was developed using the multibenefit approach. Much of the credit for its success is due to the good support and co-operation we received. In addition to private landowners and the provincial government agencies, specifically the Ministry of Environment, other groups including the National Second Century Fund, the Nature Conservancy, the Canadian Wildlife Service, the B.C. Wildlife Federation, and the Federation of B.C. Naturalists made significant contributions.

In the securing and developing of habitat in the future the co-operation among these and other agencies must continue and grow, and the concept of multipurpose, multibenefit development must be considered whenever possible. Ducks Unlimited plans to continue to use this approach for their program in the 1980's.

CURRENT PROBLEMS

CATTLE-WILDLIFE INTERACTIONS

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Probably the first thing that comes to mind when we think of "land for wildlife" is the land base itself, the space that is required by each species. But in the closing decades of the 20th century the second thought that better come to mind, quickly, is the matter of other land uses and possibly competing uses. In this paper I will focus on one such potentially competing use--the grazing of cattle, and its interactions with mule deer and grizzly bear. Please bear in mind that in 10 minutes I can not get very specific, and you will undoubtably be able to think of exceptions to much of what I say. I must confine my comments to only 2 wildlife species although conflicts may occur with others.

Let us first consider the interactions of grizzly bear and cattle. This has been a continuing area of concern and controversy with lots of publicity about Gang Range occurring in the middle 1970's, and with renewed concern recently. Many believe that cattle simply can not be grazed where there are grizzly; and where there are cattle the grizzly can never return. I suggest that this is not true.

A rancher near Lillooet has for 14 years grazed approximately 150 head of cattle in a subalpine area where there are probably more grizzles per 100 cows than any other place in the province. Let me summarize his experiences:

- no losses in the last 2 years and several bears were observed;
- in the previous 12 years, 5 cattle died. For 2 of these the cause of death was known not to be predators. In the 3 other cases, the rancher concluded that the evidence did not indicate a predator kill;

- cattle have been observed bedded down calmly watching a grizzly digging.

From that experience I have concluded that grizzly and cattle are quite compatible, at least where:

1. the cattle and bears are widely separated when the bears come out of hibernation and;

2. the animals do not mix until mid-July or later.

By then the calving season is well past, with its temptations to predators, and the cattle reaching the bear country are strong, healthy, and the calves are big. Furthermore, the bears have settled into a routine that does not include eating cows. I could wish that black bear caused so few problems. In the southern interior something under 1/4 million head of cattle spend part of the year grazing on crown range. Most of this range is also mule deer habitat. Severe conflicts between cattle and mule deer can occur and that is the bad news. The good news is that such conflicts are most apt to occur in a narrow space of time and on a relatively narrow slice of the habitat.

Let us look at a typical cross-section of a landscape that might occur in the Kamloops-Okanagan-Lillooet area. Starting at river level in a valley, we often find irrigated hay fields on adjacent benches. The native vegetation would be bunchgrass and sagebrush. Persistent snow cover is light. The adjacent Ponderosa pine-bunchgrass community is similar, and usually of limited extent. Moving higher, the Douglas-fir--Pinegrass forest is much more extensive. The temperatures are cooler, and 1-2 or more feet of snow may persist for several months. The Engelmann spruce-subalpine fir zone forest occupies much of the plateau area at upper elevations. Three to five feet of snow may persist through most of the winter. Stands of lodgepole pine may occupy sites in either the more moist Douglas-fir zone, or the drier Englemann spruce-subalpine fir zone. Clearcuts are common in the Lodgepole pine and spruce types. Sedge meadows may be locally important. In mountainous areas there may be a band of alpine forest, true alpine (above tree line), then steep talus slopes.

Deer typically winter in the dry Douglas-fir type, browsing on Saskatoon, snowbrush, current, willow, some rose, and considerable Douglas-fir. "Brush in the sun" is the critical need during this season. Big sagebrush and pasture sage are used at lower elevations. When the grass first begins to grow the deer will move out into the grasslands to take advantage of the first green forage of the year. During May they are moving into the Douglas-fir forest, and then beyond, and much of their diet through the summer will consist of forbs. By fall they will be using mostly shrubs. As they drift back towards their winter range, they will tend to stay at higher elevations if weather permits as part of a natural rest-rotation grazing system. However, when the weather gets tough, the deer move back into the low snowfall areas where there is good shelter, lots of shrubs, and preferably south-facing slopes.

Cattle tend to follow a similar pattern, but one with significant differences. They are normally wintered on hay, and are not turned out until well into the spring. By June they are on Pinegrass range, later possibly using meadows, or seeded clearcuts. A few ranchers are privileged to use the highly nutritious forage in the subalpine. By September the cattle will be drifting down, and by October most will be on grasslands or hay fields.

During the spring, summer, and fall, conflict between cattle and deer requirements is minimal. There are several reasons for this, the major one being that the animals are not restricted in what areas they can use. Also, diet overlaps are not that great. However, as winter sets in, the deer begin to concentrate, and in severe winter weather they are restricted to a very small fraction of their total range. It is on this critical winter range that the conflicts can be severe. Typically, the critical deer winter range lies in a band between the cattle summer range and their late-fall range or the hay fields. Therefore, the cattle will be crossing the deer winter range. This gives rise to a potential problem because in the fall the cattle's diet preferences have changed. During the spring and summer, cattle are generally grass eaters, using also some forbs. However, in September and October the protein content to some grasses and forbs drops drastically, the fiber content rises, and the palatibility diminishes. However, the nutritional level and palatability of shrubs do not decrease to nearly the same extent. If cattle are allowed to concentrate for any length of time in the fall in areas that are critical for deer winter use, the stage is set for severe conflict. They may browse off significant amounts of Saskatoon, willow, current, Snowbrush, Red Osier dogwood, and Rose--species important for deer winter use.

There is the problem, now what is the solution? The first and obvious one is to simply not allow fall cattle use of deer winter range. This is done wherever possible. It often implies a fence on the upper edge of the range, with cattle being gathered and moved thru the winter range under control. In many cases prohibiting use is not feasible, but severely limiting use is. Techniques here include placing no salt in the critical area since salt attracts and holds cattle, and insisting the cattle be driven out of the area frequently, possibly 3 times per week. Rotation grazing systems that allow only 1/3 to 1/5 of a slope to be used in a given fall offer a potential solution. However, great care and much accurate knowledge must go into the design of any such system or we may succeed in locating all the critical deer winter range in one pasture, with a potential for a disaster every 3-5 years.

Careful, on-site observations by experienced people are necessary to quantify the problem and to recognize potential solutions. For example, I recently inspected an area of Class 4 and Class 3 deer winter range. I had proposed that this area be grazed only in June.

The rancher suggested that this was not practical due to Timber milk vetch which is most poisonous in early summer. I agreed to a trial period of fall use with considerable concern. So far, the cattle have moved right through the logged Douglas-fir--Pinegrass areas onto grassland slopes and benches where conflict is almost nonexistent. If the timing of roundup is correct, conflict in this area will be minimal. Now, I have said that potential conflicts can be resolved. Possibly some of you are asking; "are they being resolved?" In an encouraging number of cases they are. In the last 10 years I have seen progress made in obtaining better management of the crown range.

In the area around Kamloops, for example, there are a number of examples of deplorable conditions that have improved strikingly in the last 5 years. But, I would be less than honest to suggest that all is well and if I did some of you would probably set the record straight. Our effectiveness is still suffering from some organizational problems, particularly ones that tend to divorce experienced staff from the field and from contact with the users. And this is where experienced, competent, personable staff are critical if on-the-ground management changes are to occur. Through the years I have observed that we can have coordinated plans, interministry agreements, and write lots of letters. But until we spend time on the ground with the cowboy, the skidder driver, or the trail biker, meaningful management changes do not occur. Possibly, too, we are still growing into our recent legislation. The Ministry of Forests Act is one of the most important pieces of natural resource legislation in the province. In Section 4 it states:

> The purposes of the functions of the ministry . . . are to:
>
> (b) manage, protect, conserve the forest and range resources of the Crown having regard to the immediate and long term economic and social benefits they may confer on the Province:
>
> (c) plan the use of the forest and range resources of the Crown so that the production of timber and forage, the harvesting of timber, the grazing of livestock and the realization of fisheries, wildlife, water, outdoor recreation and other natural resource values are coordinated and integrated . . ."

Its a bit of a struggle for some to realize that to coordinate and integrate means more than to log and let all other users do what they can with the stumps. However times, and minds, are changing. Certainly our failures can no longer be blamed on lack of a clear mandate or responsibility. The reorganized Forest Service, with full responsibility and accountability, delegated to the district manager level, is in a much better position to attain integrated resource management than in any previous time in its history.

FOREST SUCCESSION AND WILDLIFE IN WELLS GRAY PROVINCIAL PARK

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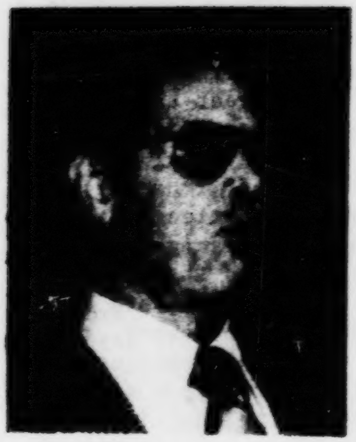

INTRODUCTION

Wells Gray Provincial Park which occupies 534,000 hectares in south-central British Columbia has escaped major habitat disturbances by man. However, natural fire and subsequent forest regrowth or secondary succession have been followed by major changes in mammalian populations. My purpose in this paper is to describe some of the observed changes in abundance of several species of large mammals in the 1950-1981 period and relate these to forest regrowth.

Three biogeoclimatic zones (Krajina 1965) have been mapped. The largest, subalpine Engelmann spruce-subalpine fir occupies 321,000 hectares at midelevations. Above this is 45,000 hectares of alpine tundra and 3000 hectares glaciers while low elevations are largely encompassed by 154,000 hectares of the interior western hemlock zone. A fourth zone, interior Douglas-fir, occurs in small isolated patches but is not mapped.

The park has a history of pine with most of the interior western hemlock zone having been burned in fires of the 1920's and 1930's. Edwards (1954) described changes in mammalian populations brought about by the 1926 fire that deforested 200 square miles in only a few days. The changes included a crash in the caribou population some ten-years after the burn, a rapid increase in the mule deer population and, later, a similar increase in the moose population.

MOOSE

The preferred food of moose, upland willow, is an effective invador of large burns in both the interior western hemlock zone and the subalpine zone. Its light seed travels much farther than that of conifers and is less likely to be consumed by birds or rodents. Willow regenerated heavily following the 1926 fire.

The increase in both moose and deer was dependent on a vastly increased food supply. However, few moose had reached southern British

Columbia by 1926 so an immediate population response to increased forage was not possible in Wells Gray Park. The increase must have been rapid, however, because by 1952, after an aerial survey Edwards (1952) estimated that 2300 moose were wintering in the park. Assuming that there were only two dozen moose in the park in 1926, a 20% annual increase would be needed to achieve this population by 1952, a not unlikely rate of increase. Three population estimates of over 2000 in 1954, 1957, and 1958 were obtained by equating the ratio of tagged to untagged moose in the hunter harvest with the ratio of total tagged moose to the total population (Petersen Index). A fourth Peterson estimate in 1959 gave about 1600 animals. In the sixties and early 1970s, a continuation of the downward trend was evident with declining hunter harvests and fewer moose reported on aerial surveys.

The underlying cause of the moose decline was a reduction in the amount of winter forage available to moose. A series of fall measurements of available annual growth in 90 willows recorded this decline from 1951 to 1966 and on a sample of these willows in 1974 (fig. 1). The decline in moose harvests (fig. 2) parallels the decline in available willow forage and is a good barometer of the declining population.

Utilization of available willow did not decline appreciably during the study period (fig. 3). There were always enough moose to consume about 60% of the annual growth in a normal winter with utilization being dependent on the severity of the winter.

The deadline in willow production was unrelated to severity of browsing. Some willows were crowded, shaded, or otherwise out competed by larger tree species. Others grew out of reach. The winter range was simply aging or undergoing successional changes leading to a permanent or climax vegetation.

We found that it was possible to retard succession and to duplicate high browse production of earlier burns by slashing vegetation or by burning it. Prescribed fires in 1968 covered several of the willow lines that had been measured annually. On these fires, production rose from 7133" in 1967 to 15,095" when remeasured in 1974, a gain of 112%. On five lines not burned, production fell from 23,516" to 10,661", a loss of 55%.

However, benefits were short lived especially in the slashed areas. It is unlikely that original moose populations could be restored to the levels of the 1950's by burning because variability in fuel loading would make it impossible to equal the size of the regional burns. In addition, intensity of secondary burns would be much less than in the original burns. In smaller burns early seral stages are quickly replaced by coniferous species.

CARIBOU

The woodland caribou is southern British Columbia's dependent on climax or old growth coniferous forests at high elevations. In Wells Gray Park fire drastically reduced the size of caribou winter range in

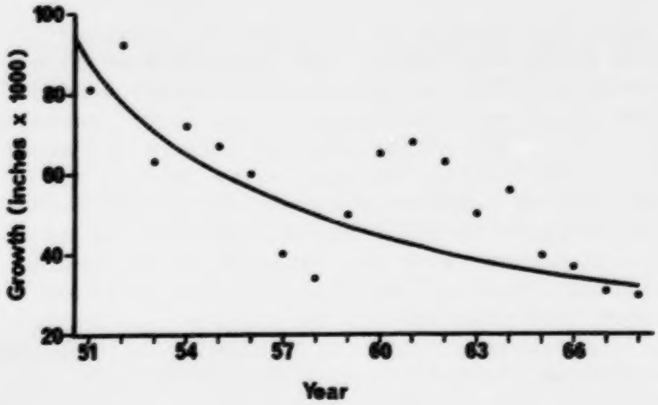

Figure 1.

Annual growth in inches of 90 marked willows: Wells Gray Park

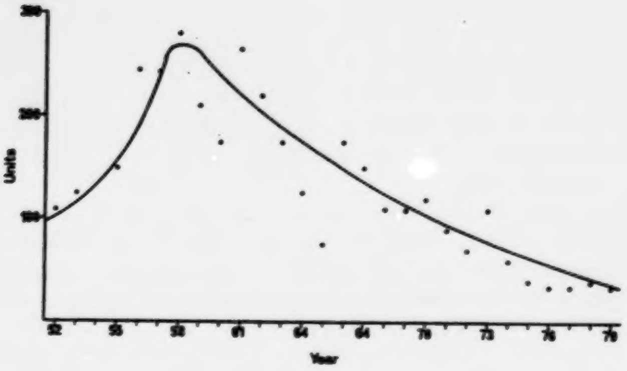

Figure 2.

Moose harvests in Wells Gray Park
Sources: 1952-1962 Hunter checks in Wells Gray Park; 1965-1975 Hunter harvest estimate for M.A. 12 corrected by factor of 0.56; 1975-1980 Hunter harvest estimate M.U. 3-45, 3-46

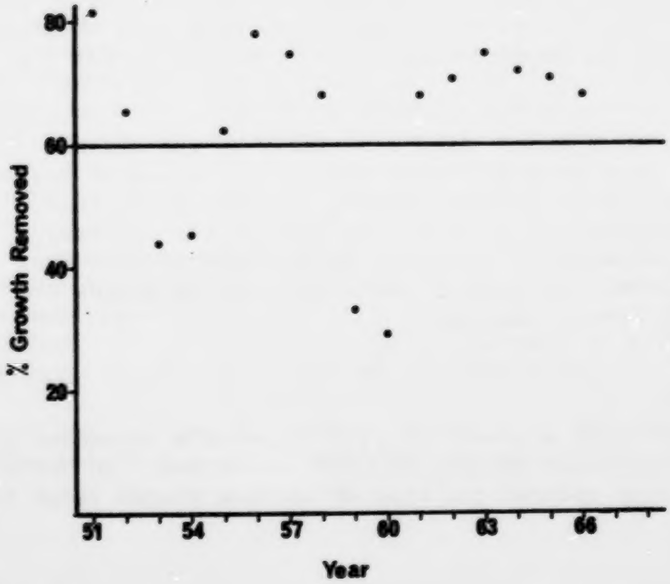

Figure 3.

Trend in browse utilization from 90 marked willows in Wells Gray Park the 1920's and 1930's as described by Edwards (1954). The population could no longer be supported in numbers that existed prior to the burns and a decline was noted some years after the fires. The exact mechanism of population reduction is not known although predation, hunting, emigration, and starvation have all been suggested. Indeed these factors may have temporarily depressed the population below the long-term ability of the range to support it.

Population size prior to the decline is unknown. However, from reports of herd sizes in the southern park, I would estimate that at least 700 animals were in the park prior to the extensive burns of the 1920's and 1930's. After Caribou population recovery was well underway, in 1954 I estimated 220 caribou in the southern part of the park. In retrospect I consider this number to be optimistic.

Hunting of caribou was re-opened in 1955 after a closure of 15 years and rising harvests indicated a general increase in numbers as did field observations.

The first attempt to obtain a Caribou population estimate for Wells Gray Park came in 1964 when a census of July snow patches by Super Cub located 140 caribou in 8 1/2 hours; in 1965 the survey was repeated using a helicopter but poor weather was encountered and only 51 caribou were found in 9 1/2 hours. In 1970, a helicopter survey supplemented with fixed wing aircraft located 338 animals from a population I estimated at between 350 and 400 animals. Subsequent summer surveys in 1975 and 1980 located only 97 and 79 animals. These results combined with those of winter range surveys suggest a rather drastic population decline.

Overhunting has been suggested as a cause of the decline in numbers. However, the peak census figure of 338 in 1970 came after the period of highest winter harvest recorded. Subsequent legal harvests were curtailed by restricting season length, hunting areas, and finally a complete closure of the season in Wells Gray. Illegal harvests are suspected to be responsible for reducing population size in the Trophy Raft-Acola Mountain areas immediately outside the park.

My interpretation of these changes in numbers is that caribou declined in the 1930's as a result of range lost to fire as described by Edwards (1954). Caribou probably overutilized their shrunken ranges before their numbers dropped. This prevented an early recovery. The exact cause or causes of mortality are not known but the question is academic for the population that once existed could no longer be supported by the range available to it.

Recovery of ranges produced population increases in the 1950's and 1960's despite natural and hunter predation. The population decline noted through the 1970's was coincident with further habitat loss to fire within Wells Gray Park and to fire and logging of winter ranges adjacent to the park. Illegal hunting may have depressed the population below the number which could be sustained by the present range. However, the population can not increase to its former numbers because of the reduced area of suitable habitat now available.

LARGE PREDATORS

Predators have followed changes in abundance of ungulates. Cougar were abundant prior to the collapse of the deer population in the late 1940's. Timber wolves were numerous until the late 1940's when poison and hunting reduced their numbers. From 1952 and 1965 their numbers in the moose winter range remained fairly constant at somewhat less than 20. Much of their winter food was carried on during the time of high hunter harvests and it appears that they had little influence in controlling moose abundance.

Probably changes in other mammalian populations have been even more marked in the ungulates and large carnivores. Columbian ground squirrels were once abundant in the open burn areas of the lowlands but are now mainly confined to fields and openings around natural meadows.

OVERVIEW

Species composition and age of forest stands, in other words successional stage, are dominant factors in determining abundance and species composition of wildlife in Wells Gray Provincial Park. Forest management in much of British Columbia is eliminating old-growth climax vegetation through the use of short rotations. On the other hand by effective control of wildfires, replanting burns, and legged areas with conifers it has reduced both the extent of early stage vegetation and the length of time it can persist.

Parks such as Wells Gray provide areas where natural forest succession can occur on a grand scale. Old growth forests of sufficient size will remain to support woodland caribou. In addition, given an enlightened fire management plan, wild fires could over time be permitted to produce burns large enough to support high populations of wildlife dependent on early seral vegetation.

Without such large wild areas we would no longer be witness to the almost tidal ebb and flow of deer and moose populations in response to fire. Nor, in all probability, would we be able to preserve the woodland caribou, a species dependent on large areas of climax vegetation.

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CARIBOU IN CRISIS

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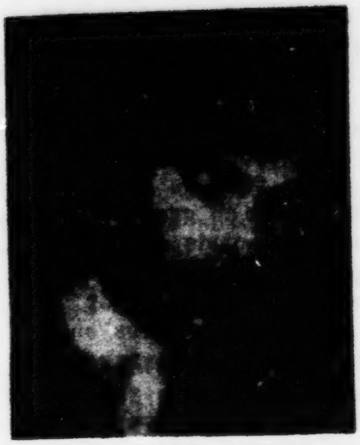

The objective of this presentation is to describe some of what is known of the characteristics and requirements of British Columbia's woodland caribou and in particular the growing crisis confronting them in the North Thompson River area. I will include a short overview of caribou continentally for some perspective.

In Canada, caribou statistics are dismal. At the turn of the century, the estimated total population of barren ground caribou was about 2.5-million animals. A 1967 census indicated their number was fewer by 80%, or about 357,000 animals remaining.

In the north, declines may have been associated with predation on calves by wolves, bears, and wolverines. It has also been suggested that continental decline of caribou is, in part, due to a 35-year general warming trend that shrank summer snowfields needed for the animals escape from biting insects.

In more southerly regions, as early as the 1920's, caribou had become extinct in the Queen Charlotte Islands and three east coast provinces. Since that time, their distribution has been reduced in southern Ontario, Quebec, and British Columbia. European settlement and accompanying land clearing, fire, overhunting, and natural predation are generally considered to have been the causes. Whatever the reasons for past caribou declines, the removal of winter habitat facing the caribou of the North Thompson River needs little interpretation as to the possible result. Remove the supporting environment and the caribou will disappear.

All caribou or reindeer belong to a single species. Canada has four native subspecies, only one of which, Rangifer tarandus caribou, is found in British Columbia. Of these there are two distinct and genetically differentiated ecotypes, approximately 9,000 Osbourne and 2,000 Woodland caribou.

In Canada's north, the tundra caribou wander great distances seasonally from the arctic tundra to the boreal forest. To the south in British Columbia, small groups of Woodland caribou find parallel habitat by vertical movements on rolling mountain slopes and benches between the alpine tundra and subalpine forest.

Both the high latitudes and high elevations have severe climates. Vegetation growth is limited and slow. The mountain caribou is well adapted to these conditions. Heat loss is minimized by guard hairs, fine underfur, and a compact body. The muzzle is blunt, the ears and tail are short and all well furred. Travel on snow or soft ground is assisted by widely-spreading hooves. Its unusually large feet undergo seasonal changes to cope with varying conditions.

Woodland caribou are primarily grazers. Flowering plants, lichens, grasses, horsetails, and deciduous leaves make up part of their varied summer diet. In winter, much of their food is withered or unavailable under deep mountain snow. At this time, food is almost entirely restricted to a single source; the lichens which grow on old stands of trees found at high elevations. About ten pounds of lichen a day are required for, at best, a maintenance diet. It is this winter food specialization that makes the remaining Woodland caribou most vulnerable. Hundreds of years are required to replace the trees and lichens that high elevation logging and fire are rapidly removing.

Before caribou can be managed and protected it is necessary to know what their local requirements are. The Woodland caribou of the North Thompson have been studied at various levels of intensity since 1950. Early studies carried out on foot and snowshoe lacked the sophistication of current methods but contributed valuable knowledge about general movements and food habits. Through 1978 to 1979 the Kamloops Fish and Wildlife Branch carried out an intensive study to further describe seasonal movements and habitat selection of caribou in the North Thompson watershed. These animals are now among the best understood in the province. Biologist Ted Antifeau tracked a bull and three cow caribou fitted with radio collars. During a one-year period, 222 locations, over a large area, were established from both the ground and the air.

The activities of each collared caribou was representative of general caribou behaviour in the study area. Each caribou was part of a group of six or seven others. These bands were fairly loosely knit, occasionally subdividing into two groups or joining others. Over a one-year period, caribou spend most of their time (56%) in the mature spruce-balsam zone above 1600 meters. It is in this zone where logging is taking place that the greatest abundance of lichen is found. From mid-December to April the only feeding by caribou that was observed was on tree lichens. Logged or recently burned areas were not used by caribou for feeding.

The patterns of caribou movement were found to be far more complex than for any other member of the deer family. Several factors complicated the generalized movements to seasonal ranges within the home range. Caribou are restless animals. Even when feeding, they are on the move. This is particularly noticeable in winter when their tracks show what look like drunken wanderings, here to there, from tree to tree, stopping occasionally to select a bit of lichen hanging from tree trunks, branches or picking up what has been blown to the surface of the snow. Caribou do not heavily graze the slow-growing lichens in one small area, but tend to graze lightly over fairly large areas. Their ability to travel in snow of varying conditions and depths ranging to ten feet is very important to feeding movement.

Caribou are also finely attuned to changing weather and snow conditions. In a year, four major vertical movements were recorded ranging between 600 and 2000 meters in elevation. In late summer and late winter, caribou were at their highest elevations. In early winter and early summer, at the lowest. Within this general vertical movement pattern, in winter there are shorter vertical adjustments, apparently in response to sharp changes in temperature or heavy snowfalls. A third feature which complicates caribou movement is due to the nature of the mountainous terrain they inhabit. To move even fairly short distances horizontally often requires longer trips down, up and out of valleys or over ridges. Movement corridors can be of great importance.

The four radio-collared caribou had home ranges varying between 319 to 662 square kilometers. This may appear to be a light intensity of use but MacGregor (1981) asserts it is consistent with the prudent life strategies of climax species such as caribou with low reproductive rates, behavioural mechanisms to prevent overuse of range, and narrow tolerances to environmental variables. The evidence supports the need of Mountain caribou for extensive stands of mature, high-elevation forests.

While the removal of lichen-bearing trees erodes the source of caribou winter food, the road access provided by logging brings additional pressure from hunting. Region 3 hunting regulations have reflected this concern and in each of the last ten years caribou hunting regulations have been made more restrictive. In most areas hunting has been closed completely. This has ensured that legal harvests, two animals since 1977, have been well below recruitment levels and over hunting has not occurred. Road access to high elevations means increased opportunities for viewing, hiking,and other recreation, but illegal hunting may also increase. The conservation officer responsible for the North Thompson area is aware of seven caribou killed illegally since 1977. If this is only a small fraction of the total then poaching could be the main short-term cause of declining caribou numbers.

While the poacher's bullet kills the individual animal the removal of habitat ensures the population will not continue to exist. It is ironic that the time remaining for the North Thompson caribou can be foreshortened, both in the present and long term, by a related cause. The logging road network which provides for the removal of the high-forest habitat also gives the poacher access to the caribou.

As first and second logging cuts are completed at lower elevations, the edge of logging activity and road access in the North Thompson River drainage is reaching upwards toward the limits of tree growth. High elevation logging, above 1500 m, is now fairly extensive in the North Thompson and it has accelerated. There are no large undeveloped drainages available to move into as alternatives.

In 1980 Ralph Ritcey, Kamloops Fish and Wildlife Biologist, stated that in as short a time as 20 years, at the then present tree cutting rates, there would be no caribou in south central British Columbia outside Wells Gray Park. Even some of the park caribou would be endangered as they come outside the park in winter to areas designated for logging.

Weight has been added to his words. The North Thompson caribou censused in 1980 showed a 25% decline from 400 to 300 animals since the last count in 1975. Group sizes were smaller and of 13 areas, 11 showed lower numbers. These caribou have been surveyed at 5-year intervals since 1965. Each count since 1970 has indicated fewer caribou than the last. Irreplaceable genetic material is being lost and the population is rapidly decreasing to the point where their ability to survive a natural catastrophe will be questionnable.

What has been done to save the North Thompson high elevation caribou habitat? Regional negotiations between the Fish and Wildlife Branch and Forest Service began in 1973 have not been successful in ensuring maintenance of sufficient habitat for existing caribou numbers.

In 1978, the Environment and Land Use Technical Committee established a Steering Committee chaired by the ELUC Secretariat and representatives of Fish and Wildlife and Ministry of Forests. In addition to an information exchange, four options were designed to allow for a range of interests within the conflict. However, no agreement has been reached based on these options.

Both management agencies face a difficult problem. Fish and Wildlife is most concerned with the maintenance of the species within the North Thompson region and the genetic diversity found within the province. While sharing this concern, the Forest Service must address management for timber production which emphasizes the replacement of old-growth stands with young more rapidly growing trees harvested on short rotations. The problem of caribou and logging is not unique to the Thompson-Nicola but is found, to varying degrees, in other regions.

Selective logging, as a solution, was studied by Stevenson in the Kootenays in 1979. She concluded that even a 20-inch diameter stump height prescription would remove 74% of the standing lichen load. Stevenson recommended that selective logging be limited to areas used by caribou as travel routes and then only on an experimental basis. No logging should be carried out in areas where caribou feed in winter. Compounding the difficulty of evaluating solution proposals is that the ecology of arborial lichens is a poorly understood component of caribou habitat. Little information exists on what optimum stand density might be and there is no information on lichen growth rates.

The situation in the North Thompson has recently improved somewhat with the 1981 recalculated annual allowable cut in the Kamloops Timber Supply Area. Ten thousand hectares, yet to be defined, will be set aside as caribou habitat in areas adjacent to Wells Gray Park. In addition, logging will be suspended until 31 December 1982, in a large area designated as important to caribou emigrating from the park. Perhaps meaningful concessions for Woodland caribou are being developed.

In the near future further meetings between the Ministries of Forests and Environment are planned. It has been suggested that an inter-regional strategy for caribou management of all the central interior be developed. In the meantime, the Woodland caribou remain in crisis. Let us hope that voices will be strong and effective to support their continued existence.

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AN OPTION PERTAINING TO FLOODING THE PEACE RIVER VALLEY

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I have been asked by the sponsors of this symposium to contribute an opinion on the impact the proposed Site C dam might have upon wildlife in the Peace Valley.

First, may I thank the B.C. Federation of Naturalists and the university for this opportunity to comment. The decision that will determine the Peace Valley's destiny, once and for all time, is now drawing near. The Site C Hearings are to begin in a few days and this will no doubt be my last chance to speak for the Peace Valley.

In view of B.C. Hydro's 'Ten Year Blueprint' for our children's destiny, I should add that the next few months will likely be the last anyone else will ever have to offer an opinion on the direction of life as it is to be lived in British Columbia. Time is running out and in this power scenario, Peace Site C, as the thin leading edge of the Blueprint's wedge, is crucially important. This is it for British Columbia!

As for my own role in discussing the impact of hydroelectric generation upon the province's northern valleys I feel on safe ground. I spent forty years in the peace before B.C. Hydro's advent, and twenty long suffering years thereafter.

For many years, and long before the era of dams and Hydro's advent in the north, I had occasion to raft the Peace River in all stages from drift-choked, spring-swollen, flood-water to ice-running low water in the fall. For fifteen consecutive winters, in my fur gathering endeavours, I snowshoed the Peace Pass in what has now become the Peace Reach of the Williston Reservoir. So the Peace and I got to know each other rather well. And, strangely, I am now the only one left alive, red or white, that can tell the 'before and after' story of the Peace reach. So, as the last one able to do so, I bring you tidings from a world now lost . . .

But beyond the briefest summary, I do not want to lament about lost worlds. Gone is gone, dead is dead; so grieve no more . . .

I would rather talk about still living worlds: namely ours. The question is what are we going to do about our existing habitats to keep them living?

To summarize the impact of big pond Hydro, such as the Williston Reservoir, is simple. The water comes up, the world goes down, and life goes out, and that's it. There is really nothing more to discuss. Without big pond Hydro, all options to sustain life are open. With the big pond, all options to sustain life are no more . . .

The Williston Reservoir is the biggest desecration and waste of natural resources the western hemisphere has ever experienced. Death and destruction were strewn from Fort Ware and Fort MacLeod to Lake Athabasca, a thousand-miles east. Fifteen years later, it continues to do. And now, after destroying the upper Peace River valley, Hydro wants to do the same thing to the lower reach.

Half of British Columbia is barren rock, snow, and ice. The other half is nearly all water and terrain unsuitable for cultivation and human habitation. Its few fertile valleys are British Columbia's scarcest and most valuable land form. Hydro insists destroying them is the best option for generating electricity. I say its the worst.

And Hydro insists its version of hydroelectric generation is a fully renewable scenario. I say that is an insidious lie. I say to Hydro: just when and how do you propose to renew the bottom of the Williston Reservoir? And who do you expect to pay for the renewal?

Obviously, to B.C. Hydro, the Williston wildlife massacre was an insignificant matter. So now, as to be expected, the tone and substance of Hydro's studies tend to belittle and downgrade the significance of the wildlife values that will be affected by its proposed Site C reservoir. It becomes evident the studies are designed to show that in the provincial context, the Site C wildlife values are, in Hydro's own terms, "insignificant".

Under the heading of, "The significance of wildlife impacts that might be brought about by the Site C project", every one of Site C's 19 wildlife groupings are described in one table as "insignificant" in the provincial context. Let me rephrase this bit of profound woods lore and expertise: through its agency, B.C. Hydro, the international financial community's study is here making the flat assertion that the impact that will wipe out all life in the Site C pondage is a matter of insignificance to the province of British Columbia!

And by Hydro's formula of evaluating, how did the non-consumptive user fare? He did not fare at all! He did not even rate one "insignificant"!

As it now stands in this province, because of our politician's warped interpretation of "growth", it is patently obvious we are going to go for resource bereft and economic broke and that we are already beyond the point of no return.

But let me say this. If, in the cause of expedience, our politicians also now intend to allow the international financial community to send our children's land base, the very earth itself, down the spout along with all their other resources, then they have overreached. They have just gone one notch too damn far and they can rest assured our children through history will record them as a breed accursed. To deliberately destroy land, to render it sterile, is to inflict the ultimate indecency upon the earth. It violates all precepts, the past, the present, and for damn sure the future. Its a direct assault upon all natural laws and an affront to common decency; its patently anti-life.

In my opinion, a government has to be either very ignorant or totally uncaring, or both, if it continues to unnecessarily allow the international money lending community to wipe out the scarce life-sustaining valleys of this province. If a government has no respect for its land base, its very earth, then, it has no real respect for its people or anything else. It has no respect for me and I have no respect for it.

So much for a very sketchy resume of the land base, of living with it, and dying without it. When the big pond is ushered in life is ushered out. The land base, the very fountain of life, is destroyed.

O.K., so we have suffered through the 1000-mile Peace-Columbia valley wipe-outs, we have lived through the 2000-mile Williston-Ootsa shoreline horror shows, and we are apparently stuck with the Skagit-Kemano Two embarrassments. That was twenty years worth. So how would you like to go for 10 more? Hydro says, give us 10 more and we can wipe out the rest of the British Columbia valleys and make way for the nukes.

Many forms of wildlife show remarkable resilience and ability to adapt. Given a chance, they can roll with the punch and adapt to forest changes, agriculture, ranching, mining, drilling, or come what may. But I suggest, neither we nor they can breathe water, eat worms, or swim from here to eternity. Neither of us can adapt to big pond Hydro--ever. We have to have the land base, the habitat, or its 'game over'. Its that simple.

So what is the 'bottom line'? At the risk of being thought unduly emotional, let me tell you. Big pond Hydro is not just a simple one-time kill and a column of dollars. Big pond Hydro is an eternal scenario of converting a throbbing, sunny world into a vale of sterility and death. Big pond Hydro is patently anti-life. Because it never stops killing, big pond Hydro is the equivalent of a perpetual river of blood.

So how about Hydro, the proponent, and its environmental case for continuing to flood and destroy the major valleys of British Columbia? Let me tell you, Hydro has not got a good case; Hydro has not even got a poor case. In view of its twenty-year environmental track record in the north, 970 Burrard, fronting for Wall and Bay Streets, has no environmental case.

And the money lending community knows full well it has no environmental case. So its going to try to buy itself out with our money. Hydro calls it mitigation, I call it rationalizing mediocrity and fuzzing up the issue. I say, think it through and see the mitigation ploy for what it is, and shun it. It will let both you and wildlife down.

So this is the hour! And I say to the B.C. Federation of Naturalists, the B.C. Wildlife Federation, the Sierra Club of Western Canada, the Western Guides and Outfitters, the Outdoor Recreation Council, the B.C. Trapper's Association, the Indian People, the Organized Fishermen, the Fish and Wildlife Branch, and all others that purport to be wildlife's friends and benefactors: if you have anything to say on behalf of wildlife habitat, the life sustaining land base of your province, you had better say it now. Or be prepared to have your children live with the consequences of Hydro's Blueprinting forevermore. And you had better say it loud and clear this winter while the pitifully little that remains of the Peace is on trial for its life. It will be your one last great chance to strike a telling blow for wildlife, all life, before the Blueprint's net closes in. So I implore you, think well before you mess with mitigation, in whatever guise.

This time its for dead wildlife serious. If you are serious, you have got to act, and you must go as one voice political. Forget your differences or there will not be anything to be different about. Make a stand for land. Take a position. The issue is simple. Nail down the land base first; worry about what you will do with it last.

To save the Peace, save this, and save that is fine as far as it goes. But it does not go very far. Who is going to save British Columbia? Fragmented we fall. In this game, unless land for life is caused to happen, it will never happen.

INDUSTRIAL DEVELOPMENT IN THE NORTHWEST: FACING THE CHALLENGE

BOB HENDERSON

Western Guides and Outfitters Association, Smithers, B.C.

I was not originally asked to speak on such a wide-ranging topic as Northwest development. However, as the other participants could not attend I have tried to develop as representative approach for all our citizens as possible. In doing so I must say that I am impressed by the unanimity of northerners on the land use matters as was evidenced by the opposition to the Kemano completion project recently. If a questionnaire were sent to northerners asking why they remain in such a hostile environment, the overwhelming reply would be because of the quality of life. Certainly we in the north strongly believe the government only has a mandate to protect that quality of life; that should be the overriding factor in any decision regarding land alienation.

As I mentioned at the outset I am supposed to be speaking on the challenges facing the northwest in this decade. Believe me there are many. To start with, there are eight megaprojects of the scale of the Williston project. In hydro development there are dams proposed for Stikine, Iskut, Liard, Taku, and Skeena Rivers as well as the Kemano completion project. Associated with mineral development there are possible mines at Kucho Creek, Lawyers Pass, Letaime Lake, Mess Creek, Schaft Creek and at least 15 claims of the Amax type on the Nass, just to name a few.

There are proposals to log all climax forests on the coast as well as make substantial cuts in the interior. In addition several other projects have been considered:

- the CNR will be double tracked to accommodate coal shipments
- several pipelines
- 8 methane plants
- at least 4 proposed smelters, and
- a major extension of the Stewart Cassiar road from Dease Lake to Atlin.

In fact, Mr. Chairman, I believe it is safe to say that no one in this region is aware of all the major projects which are proposed.

Being somewhat of a pragmatist I believe that all management decisions should be made to benefit man. Recognizing that man needs a healthy environment as well as a means of expressing himself in a production sense, all land use decisions should be made ensuring that the environment will be protected, for the well being of man and beast.

Thus, just who is going to gain in the present flurry to industrialize the north in light of the fact that the present residents have clearly shown that they wish to maintain the quality of their lifestyle? Certainly there will be an increase in the number of jobs available. In fact the Northern Development Council has made representation to cabinet predicting a shortfall of 5,000 skilled jobs in our area by 1984, jobs that obviously will not be going to the present population by virtue of their skills. Certainly merchants will gain and yet most Chambers of Commerce have expressed real doubt as to the value of such projects to the long-term stability of the area. Obviously if the economic and environmental impacts of proposed projects can be made compatible with the long-term goals of the northern residents then they are more than interested in supporting them.

Since the purpose of these discussions is to formulate answers to this age-old problem of proper land use, let me give you a northerner's prospective as to how we can achieve satisfactory results. First, it appears that most of the jobs are now needed in the southern part of the province. Obviously that is the most attractive place to live, as all services are already in place. Therefore, it would seem that it would be best to maintain the annual allowable cut by logging mature stands in Stanley Park and the north shore rather that the Kwitsamateen. Certainly those areas need no further access; they are closer to markets, and are presently disadvantaged as far as being a major wildlife habitat. In fact, if they were logged they probably would support significant deer and wolf populations while we in the north would be able to set aside the last unexploited coastal grizzly habitat.

Further down the road is the sea wall, an ideal spot for coal port development as it would only require five miles of tracking from the major rail lines and would have minimal environmental impact as the harbor is probably already polluted.

I also suggest that the tennis courts and bowling greens would be ideal locations for ocelot-type plants as the transportation corridors are already in place. The dislocated tennis courts could be placed on the median of the Burrard St. Bridge thus giving them in fact more space albeit a different shape, while the bowling greens, in the spirit of multiple land use planning can go to the Granville Mall. Although the surface is not conducive to lawn bowling, studies indicate they, the Bowlers, are quite adaptable. Finally as most of the construction will be done by transient workers, the industrialization of the west end will go a long way to solving the prostitution problem in that area.

To reduce the effects of "brown outs" on Vancouver Island, it would be eminently logical to put a coal-fired generating plant on the lawns of the legislature. There are lots of other lawns in the area and it would only mean moving a few cenotaphs, no dead bodies. On the other side there would only have to be three miles of track layed from the terrains of the E & R which is at present an economically depressed line. The coal could be delivered from the Cumberland Coal fields which would add to the economy of that area. Should those fields run out, the coal could be delivered to the site by boat as it is just a stones throw from the inner harbor. It would also have the added advantage of giving cabinet a daily visual reminder of the aesthetic value of such projects.

Obviously I am being facetious. But this is the way decisions are being made and it just depends whose ox is being gored as to how well they are being received. It is my strong belief that if those whose vested interest was most seriously affected had a strong voice in the decision-making process, there would be much more respect given to aesthetic impacts of proposals.

At the present time we all seem to be too busy assuming what position each entity is going to take to come to a realization that useful decisions can be made collectively. For example, when I told my group (Western Guides) that I was speaking here, I was told that the room would be full of "little ole ladies in running shoes". Well I don't smell any rubber burning from them peeling out of here. Conversly, I received a letter from a fellow recently who was surprised to find that all guides were not big burley guys with bushy beards, red patches on the back of their neck who chew snoose. The only one who matches that description in this room is Dr. Fred Bunnell, the noted wildlife researcher at U.B.C. The point of all this being that we have become too engrossed in stereotyping leaving a major void in the politics of land use decisions.

Land use decisions are properly made in the political not the technical area. For this reason we in the north are beginning to feel more and more that we should have greater regional autonomy. To this end I am going to ask you to support the concept of a Northwest Trust. This would be a body consisting of all MLAs from the region, a representative from each regional district, and five members elected at large for a one-year term. They would be charged with the responsibility of holding public hearings into all controversial land alienations and to make recommendations to cabinet on the merits of such proposals. They should also have the ability to inquire into any decisions made by any technocrat in the public service and hold them accountable for the same.

In conclusion, responsibility for land use rests with the people and they must have some direct access to express their views in a knowledgeable way. Therefore, I ask you to support a resolution advocating the establishment of a Northwest Trust. It would consist of elected representatives charged with the responsibility of advising cabinet on the maintenance of the quality of life for both man and wildlife in the northwest region of British Columbia.

WILDLIFE AND LAND: THE VANCOUVER ISLAND EXAMPLE

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INTRODUCTION

The reasons that wildlife need land are as diverse as the number of wildlife species and there are about 600 vertebrate species in B.C. The reasons that conflicts arise between the uses that wildlife and other resources make of land are nearly as diverse. Fortunately, there are some commonalities. All wildlife species need energy, nutrients, cover, water, and habitation in some form. Similarly, many conflicts regarding land use in British Columbia relate back to five general phenomena that occur throughout the province. In treating wildlife and land on Vancouver Island I first consider five phenomena that are present throughout the province. I then treat the broad dimensions of "the squeeze" to which wildlife habitat is subject. Vancouver Island is then examined as a specific example of the general phenomena. Three species or groups of species are chosen to discuss the nature of their need for land. Finally, some implications of the general phenomena and the examples from Vancouver Island are presented.

WILDLIFE AND LAND IN B.C.

At the most basic level, relationships between land and wildlife are governed by the same phenomena throughout the province. The generality and fundamental importance of these phenomena compels review at the provincial level before treating Vancouver Island as a specific case. There are at least five major phenomena.

1. Great diversity

British Columbia presently houses the greatest diversity of wildlife of any political unit in Canada (Bunnell and Williams, 1980a). The reasons are straightforward. The topographic relief of the province is great and oriented perpendicular to the prevailing winds. Orographic effects produce a range in annual precipitation from 25 cm to 760 cm. Vertical relief provides areas ranging from near sea level to more than 3,600 m in elevation. Similarly, the province extends about 1300 km from south to north. The relief together with both maritime and continental climatic influences generates a variety of climates. The diversity of climate generates diversity in vegetation ranging from near-desert to rain forest, and from salt marsh to alpine meadow. Of the eight forest regions Rowe (1959) described for all of Canada, five occur in British Columbia. The diversity of wildlife is simply a product of the diverse climatic and vegetative regions plus the isolation provided by numerous islands, a long, irregular coastline, and the great vertical relief.

For a detailed treatment of the diversity of birds and mammals in British Columbia see Bunnell and Williams (1980a). Here I summarize their findings. A greater number of bird species breed in B.C. than in any other Canadian province or territory; 71% of the bird species breeding in Canada also breed in B.C. (table 1). Table 1 also presents the second and third ranking provinces for comparison. There are 64 species of birds that breed in only one province or territory; 35 of those (55%) breed only in B.C. (table 1). Despite hosting the greatest number of breeding bird species, the proportion of species that occurs only during breeding season is lower in B.C. than in any other province

TABLE 1. Diversity of bird and mammal fauna on Vancouver Island

Area	Number of species	% of all Canadian species	Number of exclusive species	% of all exclusive species
Breeding birds (including introduced species)				
Canada	409	100	64	-
B.C.	289	71	35	55
Manitoba	263	64	0	0
Ontario	262	64	14	22
Vancouver Island	150	37	2	3
Mammals (including introduced species; excluding Pinnipedia and Cetacea)				
Canada	152	100	33	-
B.C.	113	74	25	76
Alberta	81	53	0	0
Manitoba	75	49	1	3
Vancouver Island	36	24	3	9

Adapted in part from Bunnell and Williams (1980a).

(43%; Bunnell and Williams, 1980a). British Columbia presently provides both breeding and wintering habitat for 154 bird species-the habitats are usually different. The situation for mammals is still more dramatic. Of 152 terrestrial mammal species in Canada, 113 (74%) occur in British Columbia. Only 33 terrestrial mammal species occur in only one political unit; 25 of these (76%) occur only in B.C. (table 1).

2. Our wildlife is forest-dwelling

Despite our recognition of the importance of forestry to human lives and life-styles, few of us have considered what this concentration of timber and timber production means to wildlife populations living in B.C. The habitat affinities for most of the land-dwelling mammals of British Columbia are summarized in figure 1. River otter, beaver, and navigator shrew were excluded as being largely aquatic. For simplicity, only five broad habitat types were considered. Of 98 terrestrial mammal species treated, about 60% of the "specialist" species (those using only one habitat type) are restricted to forest cover; about 70% of all species need some forest cover to survive.

The importance of forest cover is equally important to other wildlife. At least 115 of the bird species breeding in British Columbia require forest cover, and 32 species are cavity-nesters requiring particular kinds of forests. Most salmonid fish (salmon, trout, and char) require relatively even flow-rates of cool, clear water that is largely free of silt. Forest cover helps to provide the shade and streamside stability necessary to maintain these conditions. All of the eight salamander species in British Columbia utilize forest cover, and all but the tiger salamander (Ambystoma tigrinum) appear to require it. Six of the nine native frogs and toads utilize forest cover but their requirements are less strict. However, the tailed toad (Ascaphus truei) like the Pacific giant salamander (Dicamptodon ensatus) requires clear, cold, silt-free water. These requirements are similar to the salmonid fish and are similarly enhanced by forest cover. In short, the great majority of British Columbia's wildlife--from amphibians through mammals--are dependent upon forest cover.

3. Foresters perform wildlife management

Most of British Columbia's wildlife species are to some extent dependent on, or influenced by, the nature of the forest cover present. The nature of that forest cover determines the kind of energy, nutrients, water, cover, and living space available to them. In some cases it provides a form of food or cover for which no other vegetative type can substitute.

Webster defines "to manage" as meaning "to have under control and direction". In British Columbia those who manage wildlife most effectively are those who control and give direction to the character of the forest cover; that is, the forester. About twenty years ago Giles wrote (Giles 1962, p. 460):

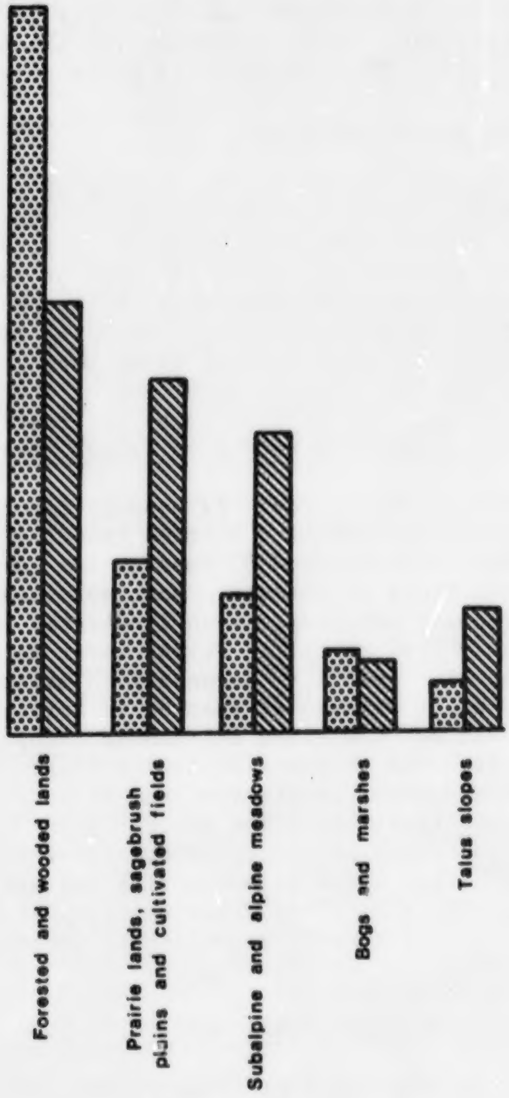

Figure 1. Total number of terrestrial mammal species found in different habitats of British Columbia. (Dotted bars indicate the relative number of species restricted to each habitat while dashed bars indicate the relative number of generalists which use the habitat at least part of the time.)

> The time has come to face up to the fact that the harvest of wood, a forester's function, has greater influence on game [wildlife] than any active technique available to the wildlifer. In one [timber] sale a forester can . . . influence more cover over a longer time than a game [wildlife] manager . . . can create . . . in a decade. The wildlifer, realizing the potentials of the wood harvest, must not only increase the effectiveness of his present practices, but must provide guidance for foresters so their efforts will not so strongly negate his efforts and can be made to complement them.

The structure of the problem is easily summarized (fig. 2).

Large-scale wildlife goals must be accomplished through timber management

because

timber management:

- * affects many acres
- * is well financed
- * employs many individuals
- * dramatically affects wildlife habitat
- * has great impact on wildlife

while

wildlife management:

- * affects few acres
- * has little financing
- * employs few individuals
- * has little influence on wildlife habitat
- * has little present impact on wildlife

Figure 2. Large-scale wildlife habitat management must be accomplished through timber management (from Thomas 1979).

Timber management *is* wildlife management. The degree to which it is *good* wildlife management depends on how well the wildlife biologist can explain the relationships between wildlife and habitat, and how well the forester can manipulate habitat to achieve wildlife goals. If properly planned and executed, timber management practices are potentially the most practical way to achieve wildlife habitat goals.

It is important to appreciate that our present problems lie not so much in the fact that foresters produce changes in the habitat for most of our wildlife species, but in the fact that these changes have not been effectively understood or administered. Over most, if not all, of North America we can observe individuals from one government agency administering changes in the habitat while individuals in another attempt, largely independently, to administer the populations residing in that habitat. Forest wildlife interactions straddle both jurisdictional (institutional) and disciplinary boundaries. The phenomenon generating the greatest confusion is the fact that nature is not divided up the way government agencies and universities are.

4. Wildlife related damage is important in forest management

The many wildlife species inhabiting our forests obtain their energy and nutrients from some component of that forest. When wildlife feeding pressure increases to the level that it kills a number of trees or seriously arrests growth, we no longer term it wildlife feeding but wildlife damage. Wildlife damage can occur at nearly every stage of the trees' growth from seeds (squirrels, deer mice, some birds) through seedlings (hares, deer, grouse) to trees 20 to 40+ years of age (porcupines, bears). Ten-years ago Bunnell and Dumont (1973) noted that 86% of the practicing foresters in coastal B.C. reported damage due to deer feeding. About 42% reported damage by grouse and 17% reported damage by other species. The economic loss to wildlife feeding is unclear and no detailed studies have been made in British Columbia. Studies in Washington and Oregon have estimated losses in excess of $5,000,000 annually, a product of direct mortality and extension of the time before the crop can be harvested. Not only do forestry practices have an effect on wildlife, but wildlife have an effect on forestry practices.

5. Public concern

Experience in the United States, where the people to wood ratio is much greater than in British Columbia, reveals that there are very real biological reasons for public concern. Kirtland's warbler was almost exterminated by fire protection in the jack pine forests of Michigan; the ivory-billed woodpecker is likely extinct in the U.S., a result of the elimination of old-growth forests and snags; available data suggest that the spotted owl could not survive without the ongoing reservation of some old-growth forest.

In a survey of professional foresters 10-years ago, 94% of them anticipated that mounting public pressure would force increased consideration of wildlife in their management practices (Bunnell and Dumont 1973). They were correct. In 1972 the Coastal Logging Guidelines were developed. Somewhat later, areas of old-growth forest were reserved as deer and elk winter ranges. Recently, the revised Forest Act specifically recognized the responsibility of the B.C. Forest Service and the forest industry towards wildlife. It did not, however, provide clear mechanisms for discharging that responsibility. Forestry wildlife interactions are not the only area where public concern has played an important role; witness livestock-predator interactions and the problems of predator control. By reflecting the complexities of the real world and recognizing more pieces of that world, public concern has made management increasingly complex for resource managers. Bunnell (1976b, p.151-152) put it this way:

> . . . foresters have changed little, but the social and natural environment in which forestry is practiced has changed greatly. Not only are more demands being placed on the same base of forested-land, but the demands come from more diverse groups. One result of the increasing diversity of demands is that wildlife habitat is no longer synonymous with game habitat but encompasses the requirements of a multitude of non-game species as well. Prognosis suggests an enormous increase in the number of decisions arbitrating use of forested lands including the exploration of very different kinds of forestry . . . the average forester will frequently encounter a dilemma in such decisions: on one hand, a professional charge to pursue what is good for the land in terms of sustained wood fibre production; on the other, a professional charge to facilitate societal ends which locally may be in complete opposition to fibre production . . .

These five phenomena which underlie the relationships between wildlife and land have clear management implications. The implications will be summarized later.

THE SQUEEZE

British Columbia is either one large problem or a great opportunity. Most of the province's land base is capable of producing more than one resource, whether it is trees, range for domestic stock, wildlife, fish, electricity, agricultural crops, or housing. In some cases man's concentration on one resource eliminates the potential to produce others. For example, land flooded to produce electricity cannot produce wood fibre, agricultural crops, or wildlife. In other cases some form of multiple resource production is possible. However, we know from simple mathematics, let alone complex biology, that we cannot maximize the production of more than one entity at a time. When we choose to manage any one resource intensively, the potential for another resource is reduced.

The squeeze experienced by British Columbia's wildlife derives from two sources. First, for economical reasons we are attempting to increase the production of several resources; notably, wood fibre, minerals, and hydroelectric power. In every case, success in increasing productivity of those resources decreases the opportunities for most wildlife in those areas. Second, we are expanding the area of impact. Simply, we are consistently taking land or habitat away from wildlife.

The examples are legion and occur throughout the province. Some, such as hydroelectric dams, are obvious and unsurprising to any of us. Others that should be as obvious somehow generate surprise or irritation. Consider a few examples. Twenty years ago coyotes were rare in the Fraser Valley and red foxes were relatively common. Clearing the land for subdivisions and agriculture favoured the coyote over foxes, and now there are complaints of coyotes killing sheep or household pets. In the Okanagan region, orchards expanded into remaining mule deer winter-range and the deer now eat apples. On Vancouver Island and elsewhere, hay fields were expanded into elk winter- and spring-range, and the elk now eat hay. In many areas of the province, forest access roads have also allowed hunter access. In several cases, notably among wildlife species with low rates of reproduction such as mountain goats, grizzly bears, and caribou, overharvest has followed. Worse, in several areas of coastal British Columbia poorly constructed garbage dumps have literally lured bears to their death. It should be no surprise at all that when we expand into some other species' habitat, that species is indeed present. Nor should we be surprised if it does not quietly give up its habitat and die, comforted by the knowledge that *Homo sapiens* is doing fine.

The few examples presented illustrate three points. First, we tend to concentrate our concerns for wildlife on a few dramatic examples: hydroelectric dams because they are so unilateral in their effects; forestry practices because they are so extensive; specific species such as killer whales and their rubbing areas, or Vancouver Island marmots because they are currently "likeable" and do not threaten our orchards, hay fields, or rose gardens. Irrespective of our apparent myopia, most of our actions *big* and *small* continuously squeeze the habitat of many species. Some amphibians, bats, flying squirrels, and the white pelican are probably in much more precarious straits than either the killer whale or Vancouver Island marmot. Second, the ways in which we deprive wildlife of their habitat are extremely varied and may be subtly indirect. There are many examples: encouraging coyotes or starlings at the expense of foxes or blue birds; changing a grizzle from an elusive, seldom observed creature to a potential danger by enticing it with garbage. Third, when we attempt to displace wildlife from their habitat we should not expect all instances to be conflict-free.

THE EXAMPLE OF VANCOUVER ISLAND

I begin by examining the general points treated under "wildlife and land" and "the squeeze" specifically for Vancouver Island, then treat three broad examples to document some of the important biological relationships.

Diversity

To compute the values of table 1 for Vancouver Island, islands a few kilometers from Vancouver Island's shore were included; more distant islands, such as Triangle Island, were not. A total of 150 kinds of birds breed on Vancouver Island as defined, which is 37% of all bird species breeding in Canada. Mammals have found it more difficult to colonize the island, and are represented by only 34 species including those introduced such as the Norway rat, European rabbit, and fallow deer. Three species are found nowhere else in Canada (fallow deer, sea otter, Vancouver Island marmot).

The respective areas of B.C. and Vancouver Island are 948,600 km^2 and 32,147 km^2. If we examine diversity on an areal basis (species/km^{-2}) we find:

	breeding birds	mammals
B.C.	0.32	0.12
Vancouver Island	4.67	1.06

B.C. has the most diverse wildlife fauna in Canada; Vancouver Island is amazingly diverse. The diversity results from the land's productivity.

Forest-dwelling

The determination of which species truly required forests was conservative. For example, among the birds such species as the bushtit, yellow warbler, MacGillivray's warbler, and the junco were assumed not to require forest cover. They do use forest cover and it is possible that such cover is required. Similarly, on Vancouver Island the raven appears restricted to areas with forest cover, but that is not true throughout its range so I have not considered it as a bird requiring forest cover. The conservative values computed indicate that 62 species of birds breeding on Vancouver Island (41%) require forest cover. Values for cavity-nesting species are similarly conservative. Those species which readily use man-made cavities or other holes outside standing trees such as the purple martin, house wren, winter wren were not included. Nevertheless, 23 of the forest-dwelling species are cavity-nesters. Two other species, great blue heron and goshawk, also have rather narrowly-defined nesting requirements. Thus, 40% of the forest-dwelling birds require narrowly-defined forest types. Seventeen of the 34 mammal species (50%) were considered to require forest cover. Among the salamanders, all six species resident on Vancouver Island appear to require forest cover. Of the three native frogs and toads on the island, none is restricted to forest cover.

Forest management and wildlife damage

The data above indicate that 41% of the breeding bird species, 50% of the mammals, and 67% of the amphibians on Vancouver Island are dependent on forest cover. Among the fish, the family Salmonidae is the most important both commercially and for the sports fishermen. Influences of forest cover on salmonid fish were noted earlier. There is no doubt that forest management is wildlife management on Vancouver Island for all the reasons noted earlier (fig. 2). Data on the economic losses to wildlife feeding experienced by the forest industry do not exist, but the losses must be significant (Bunnell and Dumont 1973).

The squeeze

Three factors are primarily responsible for the habitat squeeze on Vancouver Island: human populations, agriculture, and forestry. Other than the lower Fraser valley no area of similar size in British Columbia contains the same density of people. A square of similar size running north to encompass Princeton, Merritt, and Kamloops then east and south to include all of the Okanagan valley would rank a somewhat distant second. In terms of agricultural production, the southern third of Vancouver Island lags behind only the lower Fraser valley-Alouette area and the Okanagan. Its total production is approximately equal to that of the much larger Nicola and Peace River-Liard census divisions. When added to the impacts of forestry, these factors seriously reduce potential wildlife habitat.

Although British Columbia has only 17% of Canada's total forest land, it contains 40% of the nation's merchantable timber. The major reason for the disparity between those values is the highly productive coastal forest, of which some of the most productive sites occur on Vancouver Island. One result of this concentration of productive land is that, although the total number of sawmills is well-distributed over the southern half of the province, seven of the 11 mills with a daily capacity of more than 1200 m^3 (500,000 board feet) are located on Vancouver Island. The concentration of pulp and paper milling capacity on Vancouver Island is even more marked. Of the eight economic regions in British Columbia identified by Farley (1979), Vancouver Island trails only the central interior in terms of its economic reliance on wood and pulp products.

There are several implications to the wildlife habitat squeeze. First, because the land is among the most productive in Canada for growing trees there is little incentive to accommodate other resources such as wildlife. Second, the local economies are very dependent on the forest industry and thus desire high production from the available land base. Third, the forest industry is unwilling to tolerate significant losses to wildlife feeding from potentially productive lands. There are thus compelling reasons to practice intensive forestry on Vancouver Island. There are equally compelling reasons to practice intensive wildlife management. About 50% of the deer harvested in

British Columbia are taken from Vancouver Island. The diversity of wildlife per unit area is remarkably high. Within the forests there are 62 bird species, 17 mammal species, and 6 amphibians that are dependent upon particular kinds of forest structure. The productive capability of the land is high for *both* timber and wildlife.

Some examples

I have chosen three broad examples to illustrate the manner in which wildlife species are biologically tied to particular kinds of land: the Vancouver Island marmot, black-tailed deer, and cavity-nesting birds.

The Vancouver Island marmot (*Marmota vancouverensis*) is found only on Vancouver Island and is nowhere abundant. In March 1980 it was designated an endangered species. The isolated colonies are scattered over the mountainous spine of Vancouver Island, usually in south-facing, upper subalpine or alpine meadows bearing lush, forb vegetation. Alpine heaths apparently provide inappropriate forage or are associated with shorter summer periods. Such meadow habitats are seemingly immune to forestry practices and the marmots seem more likely to lose their land to skiing developments. Indeed, forest companies have been cooperative and have reserved from logging, subalpine forests adjacent to marmot colonies. Providing ski developments and large numbers of hikers were kept out of these colonies the marmot might be considered "preserved". Unfortunately it may not be that simple.

Some young marmots disperse; by doing so they presumably maintain gene flow between isolated populations. Young Vancouver Island marmots have recently been found on logging roads, probably searching for suitable habitat. Presently we have no evidence that logging the lower elevations between marmot colonies either encourages or discourages dispersal. It is possible that timber harvesting with resultant slash or eventual thick second-growth could inhibit dispersal. Indeed, that may be the reason dispersing marmots have been found on forest roads. It is equally possible that the vulnerability of marmots to predation is increased as they disperse across open, recently logged areas. If forest harvesting has these effects, the impact on the marmot will be unfortunate. Marmot range would gradually shrink even though man's activities had not intruded into their colonies.

It is unlikely that restrictions would ever be placed on high-elevation logging to provide marmot dispersal corridors; presently there is no compelling reason to consider such actions. There is another indirect effect of logging that could be modified. Logging roads are often the first roads into an area, after which the public claims their use as a right. *Marmota vancouverensis* is a more secretive, quieter animal than the hoary marmot (*Marmota caligata*). It may choose isolated areas for the same reason as the white pelican (Bunnell et al. 1981); it cannot tolerate disturbance. There are good biological reasons why disturbance may be critical to Vancouver Island marmots. The seasonal activity period is very short, from 4-5 months, and during that period marmots are most active on sunny days. In that limited period each marmot must assimilate sufficient food to sustain it through the long hibernation of 7 to 8 months. Disturbance of feeding activity could quickly become detrimental, and long-lasting or frequent disturbance, potentially fatal. Even if noisy logging activities were kept away from marmot colonies, the closer access to subalpine and alpine areas provided by logging roads could significantly increase disturbance by recreationists.

Neither of the two potential impacts suggested is based solely on speculation. Although there are more than 10 colonies on Vancouver Island, all are small. Furthermore, recent surveys indicate that former colonies have been abandoned and others established (Miller 1980). These observations suggest that dispersal is important to the species and may indicate that the species is susceptible to disturbance. The marmot also provides an example of an earlier generality that competition for wildlife habitat may be subtly indirect. Domestic rabbits are increasing on the southern half of Vancouver Island—either escapees or released by owners tired of plucking dandelions. Not surprisingly, as the rabbit population has increased the golden eagle has moved south. Golden eagles will not take many marmots, but given the small marmot numbers they need not to have a significant impact. Tired pet owners may unthinkingly be depriving the marmot of its land simply by helping make that land unsafe. We relearn again the first law of ecology: everything is connected.

The black-tailed deer (Odocoileus hemionus columbianus) is the most important game species on Vancouver Island. The nature of its winter range requirements clearly reveals how alternative uses can compete for land. Figure 3 illustrates the manner in which different environmental factors are thought to control deer numbers in different biogeoclimatic zones on the island (Bunnell et al. 1978). The present discussion of those factors is summarized from Bunnell et al. (1978) and Bunnell (1979). Those works and others by Jones (1975), Stevenson (1978), Harestad (1979), and Rochelle (1979) should be consulted by readers seeking greater detail. The requirements of Roosevelt elk (Cervus canadensis roosevelti) are similar to those of deer, but not identical. Hebert (this volume) treats Roosevelt elk.

Several features are apparent from figure 3. One, immediately evident, is that bedrock geology may exert considerable control in the western hemlock-sitka spruce zone. There was little redistribution of parent materials during glaciation of Vancouver Island and the present soils are closely related to the underlying bedrock. Deer numbers are best expressed on andesitic soils underlain by rocks of the Bonanza group. These soils are generally higher in nutrients, particularly nitrogen, than are tills overlying other bedrock types (Lewis 1976). If, as suggested, most soils derived in western hemlock-sitka spruce zone yield relatively poor forage for deer, that zone should be relatively free of conflicts between forestry and deer. There is little point enforcing controls on forestry practices when the ecosystem has little potential to produce deer.

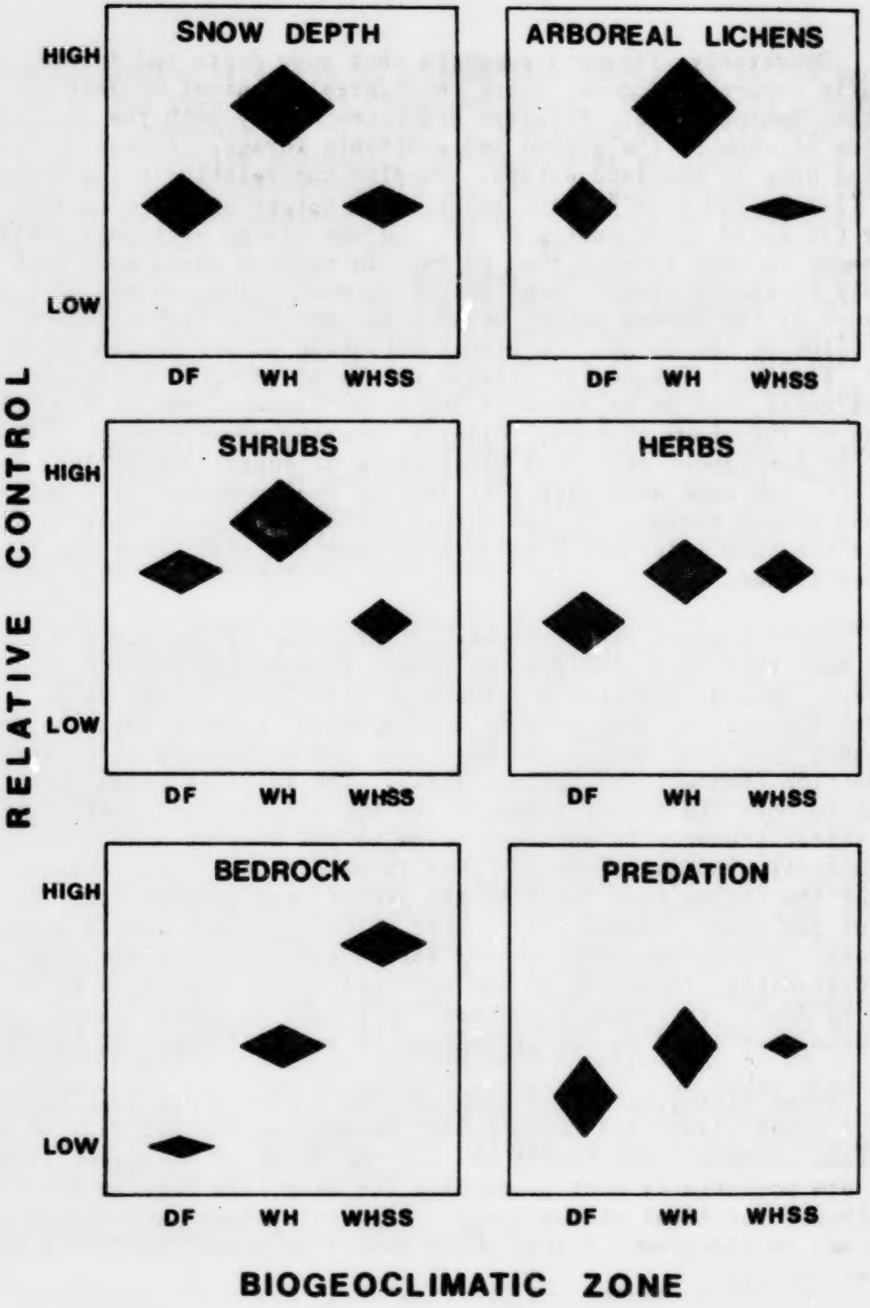

Figure 3. Key factors controlling numbers of black-tailed deer in different ecosystems. Width of the diamonds represents relative confidence in the quality of information available; height represents relative confidence in the quantity of information. Legend for ecosystems: DF = Douglas-fir zone, WH = Western hemlock zone, WHSS = Fog western hemlock/Sitka spruce zone. All sensu Packee 1976 (from Bunnel et al. 1978).

Conversely, figure 3 suggests that snow depth and forage, particularly arboreal lichens, exert considerable control on deer in the western hemlock zone. Forestry practices modify both the characteristics of snow on the ground and available forage. Potential for competing uses of the land exists. Despite the relatively low track loading (211 to 352 g cm^{-2}), the short chest height of black-tailed deer (44 to 59 cm depending on sex and age class) seriously curtails movement in snow greater than 60 cm. In regions where snow pack is likely to exceed either chest height or mean height of rooted forage, closure of the forest canopy becomes an important factor determining the value of the range. On higher elevation winter ranges (about 800 m ASL), snow pack frequently attains depths of 180-200 cm in open areas (clearcuts), 110 cm in areas of 30% crown closure, but only 30 cm in areas of 70% crown closure. Clearly, greater crown closure allows the deer to move about with less expenditure of energy due to less snow. However, the same snow pack that impedes deer movement also buries the ground-rooted forage. If the forest canopy were completely closed, it would not only intercept considerable snow but also shade out the rooted forage.

There are two implications. First, deer in the western hemlock zone must rely to a considerable extent on arboreal lichens during winter. Second, old-growth forests provide ideal winter range. Old-growth forests not only provide more arboreal lichens but also provide a canopy type that both intercepts snow and encourages understory production (Bunnell and Eastman 1976). The value of these forests is great to both the forest industry and the black-tailed deer. Value to the forest industry is obvious, value to the deer is most evident when we consider arboreal lichens. Even in mild winters deer consume about 50% of the lichen that falls to the ground, and lichens comprise about 36% of the rumen volume. The latter value increases during severe winters. Unlike the other winter forage species which are only 40 to 50% digestible, 75 to 90% of the arboreal lichen Alectoria is digestible by deer. Furthermore, lichen litterfall on winter ranges is approximately equal to the production of rooted forage, 40 to 150 kg ha^{-1}.

These biological relationships also apply in the Douglas-fir zone. Cowan (1945) and Gates (1968) documented the reliance of deer on arboreal lichens. One result is that the areas of Vancouver Island that are potentially most productive for deer also require specific attributes for ideal winter range. Presently, these attributes are best met by old-growth forest which generates direct conflicts with the forest industry.

The third example considered is that of cavity-nesting birds. These birds often constitute 30 to 45% of the avian population in forested areas (Scott et al. 1980), but can constitute as much as 66% (Snyder 1973). They are important, not simply as part of the natural environment (Bunnell and Williams 1980b), but also because they can play a significant role in the regulation of forest insect populations (Bruns 1960, Franz 1961, Otvos 1965, McCambridge and Knight 1972, Thomas et al. 1979).

Cavity-nesting birds can be divided into two groups on the basis of whether or not they excavate their own holes. Woodpeckers (primary cavity-nesters) excavate new cavities in snags and partially dead trees each spring for roosting and nesting (McLelland et al. 1979, Scott et al. 1980). Secondary cavity-nesters are incapable of excavating their own holes and must use existing cavities such as vacated woodpecker holes or those formed by rot, insects, or fire. Secondary cavity-nesters include tree swallows, fly-catchers, wrens, bluebirds, and some ducks and owls. A few birds, like the chickadee or nuthatch, are opportunists and will often use available holes even though they are capable of excavating in soft wood. The absence of a suitable nest site is often the limiting factor for populations of cavity-nesting birds (Gysel 1961, Franz 1961, Thomas et al. 1979). In British Columbia the potential problem is aggravated by the fact that forest policies concerned with fire and safety hazards call for the removal of snags at the time of timber harvest. In addition, new processes for using dead wood (Mamman et al. 1980) and a diminishing timber base have encouraged snag removal for economic reasons.

Although the impact of snag removal is a matter of increasing concern and the subject of many studies in the United States, very little research has been undertaken in British Columbia. Bunnell and Eastman (1976) reviewed nest records of the B.C. Provincial Museum for five cavity-nesting species and discussed the vertical distribution of nests and selection of tree species. More recently, Allaye-Chan (1981) examined several features of snag use by cavity-nesters on southern Vancouver Island. The nature of conflict is simple. Twenty-three species of cavity-nesters exist on Vancouver Island (table 1). For appropriate nesting sites they require larger snags or trees, preferably with some rot. Forestry practices strive to eliminate such trees. Stated most simply intensive wood production is in direct conflict with 23 bird species on Vancouver Island. This is not the place to review all the implications. It is pertinent, however, to note the essence of the findings of Allaye-Chan (1981). She studied areas that had been reserved from logging either as elk and deer winter-range or as riparian leave-strips. Her findings suggest that these areas also provide good habitat for cavity-nesting species. It is possible that areas reserved for the two major game species on Vancouver Island will also provide for the cavity-nesters.

IMPLICATIONS: PROBLEMS OR OPPORTUNITIES

The general phenomena noted earlier, the nature of the land squeeze, and aspects of the few biological relationships reviewed, have important implications. Whether we view those implications as problems or as opportunities will determine the future quality of life for both people and wildlife. These implications are most simply treated in point form. Priority is not implied by the order which generally follows the order in which background information was presented.

1. Management of the wildlife resource in British Columbia must encompass more breadth and diversity than anywhere else in Canada and in most of North America. That observation, in turn, implies a greater leadership role, a greater diversity in management plans, a greater degree of planning, and a greater budget than anywhere else in Canada. Presently, the latter is especially lacking.

2. If parks and ecological reserves are to provide land for particular wildlife species, they too must encompass a greater variety of environments than elsewhere in Canada.

3. The diverse topographic and vegetative conditions that produce the diversity in wildlife also enforce a diversity of forest practices in a wide variety of forest types. Joint management of the forest and wildlife resource is much more complicated in British Columbia than anywhere else in Canada, and likely North America.

4. "Blanket" prescriptions and guidelines are especially futile and dangerous in British Columbia. There is no panacea.

5. Most of British Columbia's wildlife resides on or near forested land to which they have few legal rights within current legislation. For much of this land, traditional economic values would assign a greater value to the forest than to wildlife.

6. Because wildlife and trees inhabit the same space, some conflicts are inevitable. Wildlife affects forestry practices, just as forestry practices affect wildlife. In areas where the capabilities for both resources are high such as Vancouver Island, the conflicts will be intense.

7. Confused jurisdictional boundaries exacerbate the conflicts that inevitably occur. Foresters manipulate habitat, wildlife biologists tend to manipulate populations; both occupy the same space.

8. Reductions of land for wildlife are a symptom of the problem, not the cause. Causes are the major modifications of the environment which occur daily. Big and small actions are responsible and they can be subtly indirect, such as access.

9. Increasing public involvement complicates management issues, increases the importance of information-sharing, and suggests complex tactics for management that will be difficult to implement.

10. Nongame species will receive increased attention despite the fact that neither the B.C. Fish and Wildlife Branch nor the B.C. Forest Service has experience or expertise with which to manage them.

Summarized simply, these ten points suggest the implementation of complex management and planning based on little expertise under conditions where conflict is inevitable. All that is true, but presents only part of the facts.

Practicing foresters have known for at least 10 years that public concern would lead to a modification of forestry practices (Bunnell and Dumont 1973). That concern has, in fact, led to changes in forestry practices beginning with the Coastal Logging Guidelines of 1972 and more recently with revisions of the Forest Act (Section 4.C; see Highsted this volume). Coordinated Resource Management Plans (Demarchi this volume, Robinson this volume) have been implemented which address a variety of resources. Strategic planning of a broader sort is also underway (Dick this volume). Although increased public involvement invariably complicates management, the public is becoming better informed and is making sound contributions (Purdy this volume). Even in areas of intense conflict, compromises have been adopted (Hebert this volume).

One of the major blessings British Columbia has is much greater flexibility in making land available for wildlife than elsewhere on earth. Our ratio of people to land is still small, we still have reserves of old forest growth, some habitats are resilient and can be restored, and, most importantly, almost 95% of our land is public or crown (Bunnell 1976a, Bunnell and Williams 1980b, Demarchi this volume, Leach this volume). Therein lie the opportunities. It is not private industry nor even government agencies that have the major responsibilities for British Columbia's land. It is the public. It is their land. Informed public involvement has proven important and helpful. Sustained involvement will ensure that the present opportunities do not evolve into choices foregone and an aggravating problem.

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IMPLICATIONS OF FOREST TENURE FOR WILDLIFE MANAGEMENT IN COASTAL ECOSYSTEMS

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The coastal species' biological requirements necessitate mature timber as critical winter range and place these needs in direct conflict with the need for mature timber for industry. Fundamental research has been conducted in the area for black-tail deer (Wilms 1971, Jones 1974, Bunnell 1979, Hebert 1979, Rochelle 1980, Schoen et al., 1981), Roosevelt elk (Janz 1980), and mountain goat (Hebert and Turnbull 1977). Cavity nesters are also important species in coastal ecosystems.

The preservation of mature-timbered wildlife habitat is hindered or completely blocked by total single-use commitments made many years ago on Vancouver Island. These land allocations took a variety of forms: private lands (25%), timber licences (7%), long-term contracts involving tree-farm licences (60%), and public supply yield units (8%).

Between 1900 and 1950, management of the forest land base in Region 1 was committed to the Ministry of Forests and the forest industry. This precluded allocation of forest lands to other resource agencies through legislation or policy. For example, although the discussion paper for the new Wildlife Act currently includes a definition of habitat and a discussion of habitat acquisition and enhancement, habitat protection on the majority of crown land is entirely dependent on interagency co-operation. Under the present organization, our only option is to rely strictly on co-operation to insure the proper management of the wildlife resource.

Management of the coastal forest land base has progressed from a single-use commitment to implied integration. In the 1980 Ministry of Forests Act it is stated in Section 4c that:

> The purposes and functions of the Ministry are to plan the use of the forest and range resources of the Crown so that the production of timber and forage; the harvesting of timber; the grazing of livestock; and the realization of

> fisheries, wildlife, water, outdoor recreation and other natural resource values are co-ordinated and integrated, in consultation and co-operation with other ministries and agencies of the Crown and with the private sector.

Although this section implies integration, Section 5-4a,b of the Forest Act states that a provincial forest tree farm licence (TFL) as well as a public supply yield unit (PSYU) shall be managed and used only for:

(a) timber production, utilization, and related purposes, and

(b) forage production and grazing by wildlife and livestock.

The latter section implies occupation of the land by wildlife, and use of cutover areas by wildlife. But it does not necessarily or usually imply use of the timber for cover and food for wildlife such as the grazing of arboreal lichen from mature trees. As such, there are no processes which allow or insure wildlife habitat, once identified, to be retained and actively managed for wildlife. At present, there is no legislation for wildlife habitat similar to the Fisheries Act or Forest Act.

The folio system failed long ago where mature timber is required both as wildlife habitat and for timber harvest. For example, it required identification of winter ranges but did little to protect them. The five-year logging plan referral uses only deferrals and does not recognize long-term protection of mature timber as critical wildlife habitat.

Ten years of biological research by universities, the Fish and Wildlife Branch, the forest industry, and the B.C. Forest Service consistently supported the need for mature timbered habitat as critical winter range. As a result, development of the Tsitika Integrated Plan produced a partial reduction in the annual allowable cut, protecting critical winter habitat for wildlife species. However, to date, it is uncertain whether the B.C. Forest Service review of TFL 39 and TFL 37 working plans will reduce the annual allowable cut to protect mature timbered critical wildlife habitat. The review is not yet complete. Opposition to a reduction in the annual allowable cut occurred in spite of these areas being the last stronghold and the most important producers of wildlife on the north island, and probably the most important on the entire island. The Nimpkish area, TFL 37, produced 10-12% of the provincial deer harvest in 1972-74 and has the potential to maintain that level.

Although the Ministry of Forests Act implies integration, there is further evidence that no process exists to implement integration. In determining the annual allowable cut for any area, the Forest Act, 1978 directs the chief forester to consider:

(a) the rate of timber production that may be sustained taking into account

  (i) the composition of the forest and its expected rate of growth,

  (ii) the expected time that it will take the forest to become re-established following denudation,

  (iii) silvicultural treatments to be applied,

  (iv) the standard of timber utilization and the allowance for waste and breakage expected to be applied with respect to timber harvesting,

  (v) the constraints on the amount of timber produced that reasonably can be expected by use of an area for purposes other than timber production, and,

  (vi) any other information that, in the opinion of the chief forester, relates to the capability of the area to produce timber,

(b) the short and long-term implications to the province of alternative rates of timber harvesting,

(c) the nature, production capabilities and timber requirements of established and proposed timber processing facilities,

(d) the economic and social objectives of the crown, as expressed by the minister for the general region and for the province, and

(e) abnormal infestations in and devastations of, and major salvage programs planned for, timber.

To date, there is no process upon which to evaluate constraints for purposes other than timber production. Consequently, the species habitat requirements for mature timber and the extensive commitment of the forest land base and harvest rate are additive. In this case, protection of coastal wildlife habitat cannot be met except by an immediate reduction in the annual allowable cut (AAC).

Both the TFL 39 and the TFL 37 working plan renewals, prepared by the logging companies, suggest that more research must be done to determine the actual need of mature timber as critical range and that something called "alternatives" must be examined. Considering the apparent agreement among Alaskan and British Columbian coastal biologists concerning species requirements for wildlife, more research is not necessary to justify a reduction in the AAC and should only be used as a refinement technique. Both working plan renewals indicate minimum ages of mature timber necessary to rotate as winter range (TFL 39 - 150 years, TFL 37 - 300 years). They suggest that if the annual allowable cut is reduced, it must be done based on a 300-year (TFL 39) and a 600-year (TFL 37) rotation. This implies that an alternate area will be allowed to grow to an extended rotation age to replace the original area selected as winter range once it is harvested.

This concept of extended rotations appears to have been misinterpreted by the forest industry in several important ways:

1. The Fish and Wildlife Branch does not have a specific minimum age of timber required for winter range. However, it does recognize that silviculture procedures combined with lichen production may alleviate the direct conflict for mature timber in certain areas of Vancouver Island. The Tsitika plan used a 150-year extended rotation only because a 240-year rotation was impossible to comprehend without a computer, when rotational logging and an 80-year logging development plan were incorporated.

2. It has never suggested alternate areas or doubling of the mature timbered area necessary as winter range. Wildlife species selected these optimum areas on the basis of a variety of vegetative, biological, climatic, and other physical factors. In the majority of cases, alternate areas do not contain these features and even under extended rotations may not act as winter range.

3. The use of alternate areas in the annual allowable cut calculation is biologically incorrect and unnecessarily exaggerates the impact of winter range retention.

Timber Supply Area (TSA) Analysis

The TSA analysis conducted during and following the Pearse Report (1976) provided timber volume information which is useful in the evaluation of policy and process affecting mature timber requirements for wildlife. In the Nootka TSA, the available timber supply over 141 years is 123,811,835 cubic meters. The sustainable yield of this area is 1,045,164 cubic meters/year while the existing timber supply commitment to the forest industry is 1,400,453 cubic meters per year or 33% greater than the sustainable yield of the TSA.

This analysis is ended by stating that reduction may be averted or reduced by forest management which insures that the forest land base does not diminish. Since annual allowable cut reduction for wildlife may be considered to reduce the land base, the statements of integration in the Ministry of Forests Act and the Forest Act may be in conflict with the TSA analysis.

It is also stated in the Nootka TSA that the productivity of forest land may be increased through investments in forest management. Preliminary analysis of the role of silviculture in mature timber retention or trade-offs suggests reduction in the annual allowable cut (removal of EPA areas in the Nootka TSA) may be accommodated by a 5% increase in productivity through the application of intensive forestry throughout the TSA.

CONCLUSION

The argument is constantly put forward that reductions in the annual allowable cut can be made every 5 years during working plan renewals, and thus, there is no immediate need to reduce the annual allowable cut. However, the current overcommitment and review of the fall down effect suggests that the annual allowable cut be reduced immediately before the problem develops to the point where annual allowable cut reductions cannot possibly be met and wildlife habitat is lost forever.

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WATERFOWL HABITATS OF THE LOWER FRASER VALLEY WETLANDS

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THE PAST

Before white settlement, rich waterfowl habitats were located in areas of the lower Fraser valley that were either permanently covered with shallow water or subjected to regular flooding. Inundation prevented the growth of trees and shrubs and so favoured aquatic food plants or fine short-stemmed grasses.

These areas comprised:

1. the narrow intertidal zones of the coastal salt-water bays and of the brackish Fraser delta foreshore;
2. the marshes on the shores and shallows of the rivers, lakes, and large ponds;
3. the flood-zone between the normal high-tide line and the abnormal or storm-tide line; and
4. the upstream flood-zone covered by the annual freshet. These four zones were of comparatively limited size in relation to the flood plain as a whole, most of which was covered by swampy forest bogs and scrub, predominently hardhack (Spiraea douglassii), willow (Salix spp.), and Pacific Crabapple (Malus diversifolia) (North and Teversham, 1976. See Forbes (1972) for details of present wetlands flora (tables 1 and 2).

The wetlands of the lower Fraser have provided habitat for 36 species of migratory waterfowl during historical times. Due to lack of time, comment here is focussed upon those species that have suffered radical change in status. The tidal flats and marshes of the salt-water bays eel-grass (Zostera spp.) sea lettuce (Ulva spp.) and glasswort (Salicornia sp.) provided the diet for a wintering population of Brant (Branta bernicla nigricans) and for a spring transient population of this species (Brooks and Swarth 1925; Munro 1977).

The tidal foreshore marshes at the mouth of the Fraser supported large stands of bulrush (Scirpus spp.), sedge (Carex spp.), and cattail (Typha spp.). Here Lesser Snow Geese grubbed up rhizomes as they do today in these localities. Farther inshore, on the deltaic islands,

TABLE 1. Flood plain lands in Delta attractive to waterfowl: 1858-1880.

(a) Habitat probably used by waterfowl		
Tidal marsh, salt marsh on islands, and present dyked upland[a]	4.5%	45.84%
Wet grassland "prairies"	41.34%	
(b) Habitat where waterfowl use was limited to streams, beaver ponds, and lakes		
Shrub and grassy bush, willow, and crabapple	18.3%	54.1%
Bog	26.0%	
Woods and forest	9.8%	

[a] Intertidal areas excluded.

TABLE 2. The Nicomekl-Serpentine Rivers flood plain attractive to waterfowl: 1858-1880.

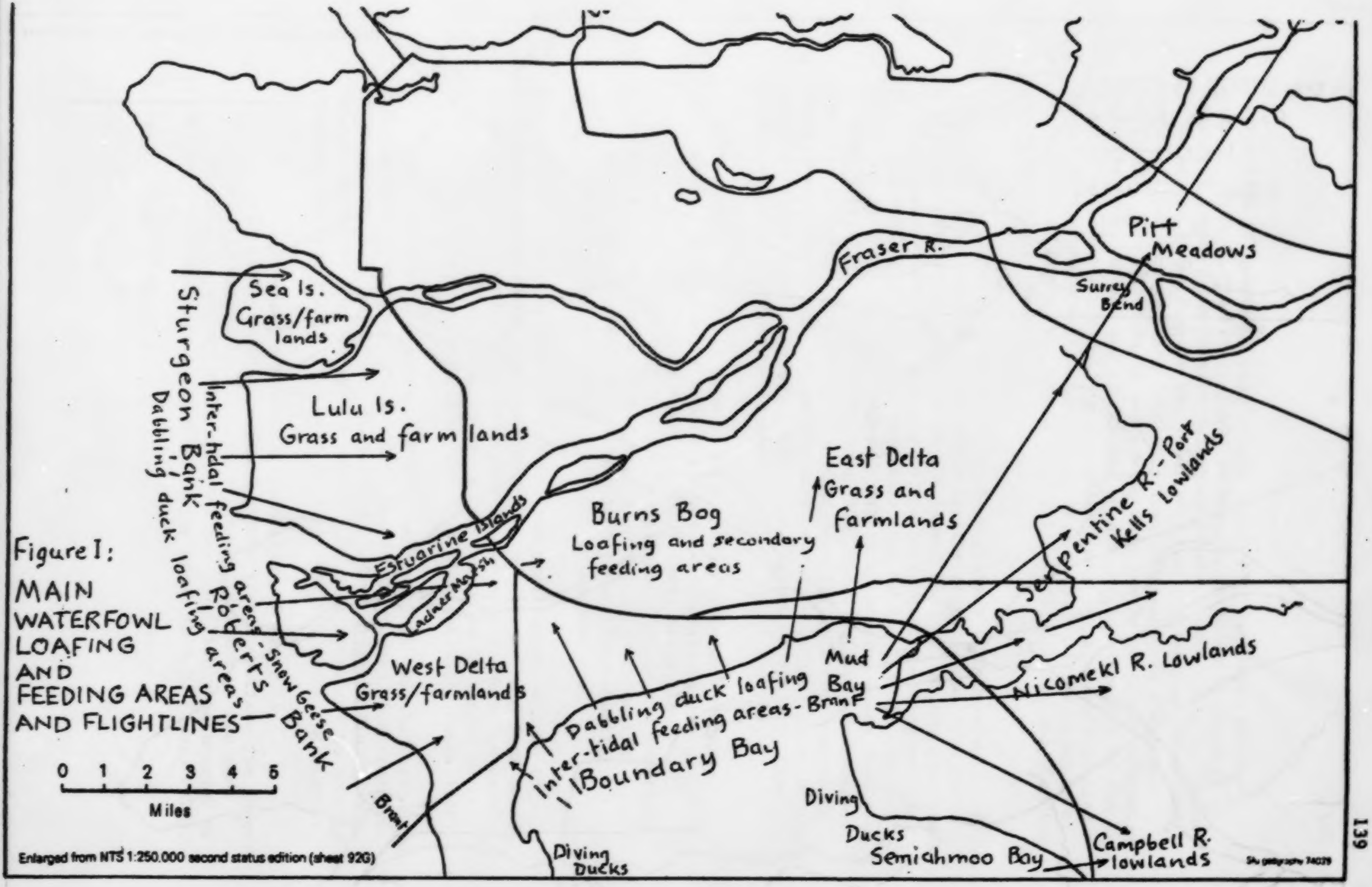
(a) Habitat probably used by waterfowl		
Salt marsh	3.44%	26.32%
Fresh marsh, grassland "prairies"	22.88%	
(b) Habitat where waterfowl use is limited to streams, beaver ponds, and lakes		
Shrub and grassy bush, willow, and crabapple	41.84%	73.65%
Bog	5.95%	
Woods and forest	25.86%	

Based on M.E.A. North, M.W. Dunn and J.M. Teversham, 1979, *Vegetation of the Southwestern Fraser Lowland*, Lands Directorate, Environment Canada.

north of Boundary Bay, east of Mud Bay, and on Chilliwack and Sumas Prairies were limited grasslands on which Taverner's Canada Geese (Branta canadensis taverneri) and White-fronted Geese (Anser albifrons frontalis) gathered in large flocks (Lord 1866; Brooks 1917). The wetter grasslands and freshwater marshes were the winter habitat of Whistling Swans (Olor columbianus) especially in localities, such as the Pitt Marshes, where Wapato or Duck Potato (Sagittaria latifolia) grew in large quantities. The more adaptable dabbling ducks wintered in all these habitats (fig. I) and a few species remained to nest in the Fraser Valley, especially Wood duck (Aix sponsa) and Mallard (Anas platyrhynchos) that were able to avoid the rising river waters in June (Brook 1917). The status of diving ducks in the coastal and estuarine waters was probably similar to that of today (see Vermeer and Levings 1977) of current conditions and habits. However, early shooting records suggest that Canvasback (Aythya valisineria) were more numerous in the fresh marshes of old. It is also probable that the Common Merganser (Mergus merganser) found more undisturbed nesting habitat on the lower mainland coast, and that the Hooded Merganser Lophodytes cucullatus bred on the many stream-fed lakes and beaver ponds that once dotted the Fraser valley (Brooks 1917).

When white settlement began along the lower Fraser in 1859-60, the natural grasslands or "prairies" were the first areas to be dyked and drained. After the flood of 1894, a continuous system of dykes was constructed along the Fraser, Nicomekl and Serpentine Rivers and along the delta coast. The larger deltaic islands were also dyked. The dykes were usually located along the beach ridges and on the natural levees of the rivers (Winter 1968). They therefore excluded most of the intertidal plant communities, the eel-grass community and the bulrush community. In contrast, salt-marshes were much reduced and grasslands entirely enclosed. At the same time uncounted sloughs, small ponds, lakes and fresh marshes were also drained (fig. II). These habitat losses undoubtedly contributed to changes in the habits and distribution of swans and dabbling ducks. However, they do not entirely explain the decline and disappearance of the field feeding geese, especially of the wintering flocks of the Taverner's Canada Goose, once "the commonest goose in British Columbia" (Brooks 1918). The dyking of the wet "prairies" was accompanied by the clearing of large areas of scrub and swamp that were converted into pasture and arable land on which forages and grains were then extensively grown. Thus, winter feeding habitat suitable for grazing geese was greatly increasing at the time of the decline of these birds. Furthermore, two inland waters extensive enough to provide secure roosts for large numbers of geese, Pitt Marshes and Sumas Lake, were drained only after the White-fronted Goose and the Taverner's Canada Goose had ceased to in large numbers in the Fraser Valley (Leach 1979).

The conclusion that must be drawn from events in the late 19th and early 20th century is that habitat loss was not the sole cause of changes in waterfowl wintering populations in the lower Fraser Valley; this factor must be coupled with disturbance, especially for pot hunting and market hunting. This is not a popular view because the



Pitt Meadows
Fraser R.
Surrey Bend
Sea Is. Grass/farm lands
Lulu Is. Grass and farm lands
Sturgeon Bank
Inter-tidal feeding areas - Snow Geese
Dabbling duck loafing areas
Roberts Bank
Estuarine Islands
Ladner Marsh
Burns Bog
Loafing and secondary feeding areas
East Delta Grass and farmlands
West Delta Grass/farmlands
Mud Bay
Dabbling duck loafing
Inter-tidal feeding areas - Brant
Boundary Bay
Serpentine R. - Port Kells Lowlands
Nicomekl R. Lowlands
Campbell R. lowlands
Semiahmoo Bay
Diving Ducks
Diving Ducks
Brant
0 1 2 3 4 5
Miles

Figure I: MAIN WATERFOWL LOAFING AND FEEDING AREAS AND FLIGHTLINES

Enlarged from NTS 1:250,000 second status edition (sheet 92G)

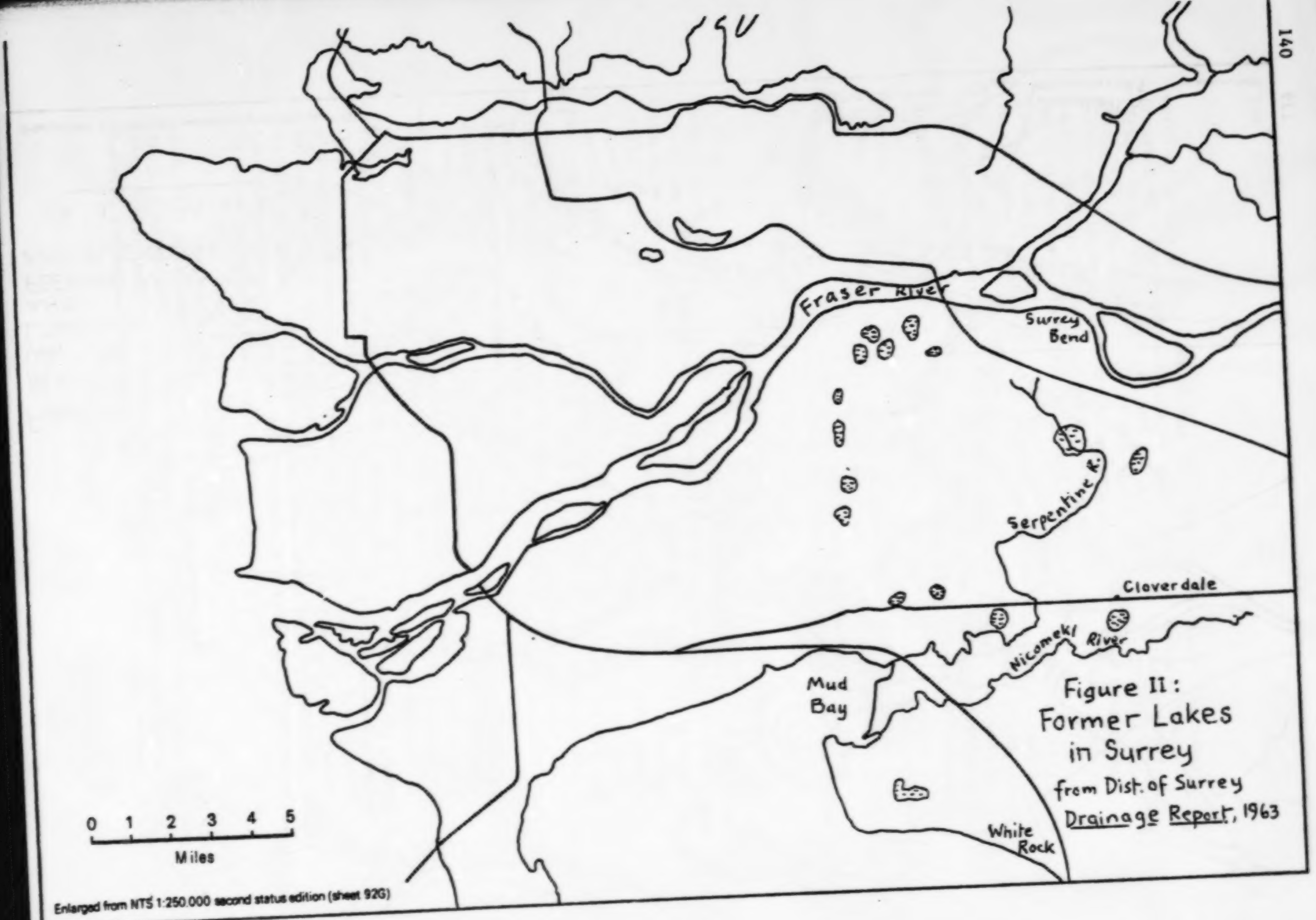

Fraser River
Surrey Bend
Serpentine R.
Cloverdale
Nicomekl River
Mud Bay
White Rock
0 1 2 3 4 5
Miles

Figure II: Former Lakes in Surrey from Dist. of Surrey Drainage Report, 1963

Enlarged from NTS 1:250.000 second status edition (sheet 92G) restoration of wintering populations reduced by such disturbance usually requires greater controls on hunting in selected areas of essential habitat, especially foreshore roosts. Nevertheless, failure to recognize those impacts has resulted in an underestimation of the possibilities for reviving lost waterfowl traditions in the lower mainland. This attitude is made worse when losses of former wintering waterfowl populations are attributed to exaggerated accounts of the loss of wetlands which fail to recognize their comparatively limited extent before white settlement, or to take account of the addition of large areas of meadow and arable land subject to puddling and flooding during the winter months.

Unrestricted hunting prior to the Migratory Bird Convention of 1916 drove the larger more desirable species of waterfowl from their traditional wintering habitats in the Fraser Valley. At the same time it discouraged them from adhering to the pattern of roosting on tidal flats and feeding on adjacent farmlands that is familiar in the Old World and is still attempted here by flocks of grazing geese from time to time (fig. III) (Leach 1972; Owen 1976). The failure of management agencies to recognize what had occurred resulted in a continuance of heavy disturbance on the foreshore marshes and intertidal zones of the lower mainland coast. In 1956, the Annual Report of the B.C. Game Commission stated complacently that:

> Waterfowl generally seem to be holding their own extremely well. This is quite remarkable when one considers the tremendous hunting pressure to which these birds are subjected. With such a large human population in the Lower Mainland and with more and more people turning to hunting as a form of recreation, all available waterfowl-shooting grounds can be considered to be put to maximum use.

Yet, in spite of this optimistic tone, the same report went on to lament that Brant were "scarce during the open season" and Snow Geese, though "abundant during the early part of the season, were "as usual . . . to be seen in offshore rafts" where few could be bagged by sportsmen (British Columbia 1956; see also Einarsen 1965; Owens 1977).

Even after the establishment of a sanctuary in 1964 had helped to stabilize the wintering population of Lesser Snow Geese, the pressure on Brant continued unabated. Finally in 1977, Provincial Biologist William Munro had the courage to report that, due primarily to hunting pressure upon the very narrow band of Brant habitat along the coasts:

> We no longer have a wintering population of brant in historic brant areas . . .. If recent trends continue few if any brant will appear in B.C. prior to the last day of the open season . . . and wildlife agencies may justifiably be accused of systematically eradicating wintering brant in B.C. (Munro 1977).

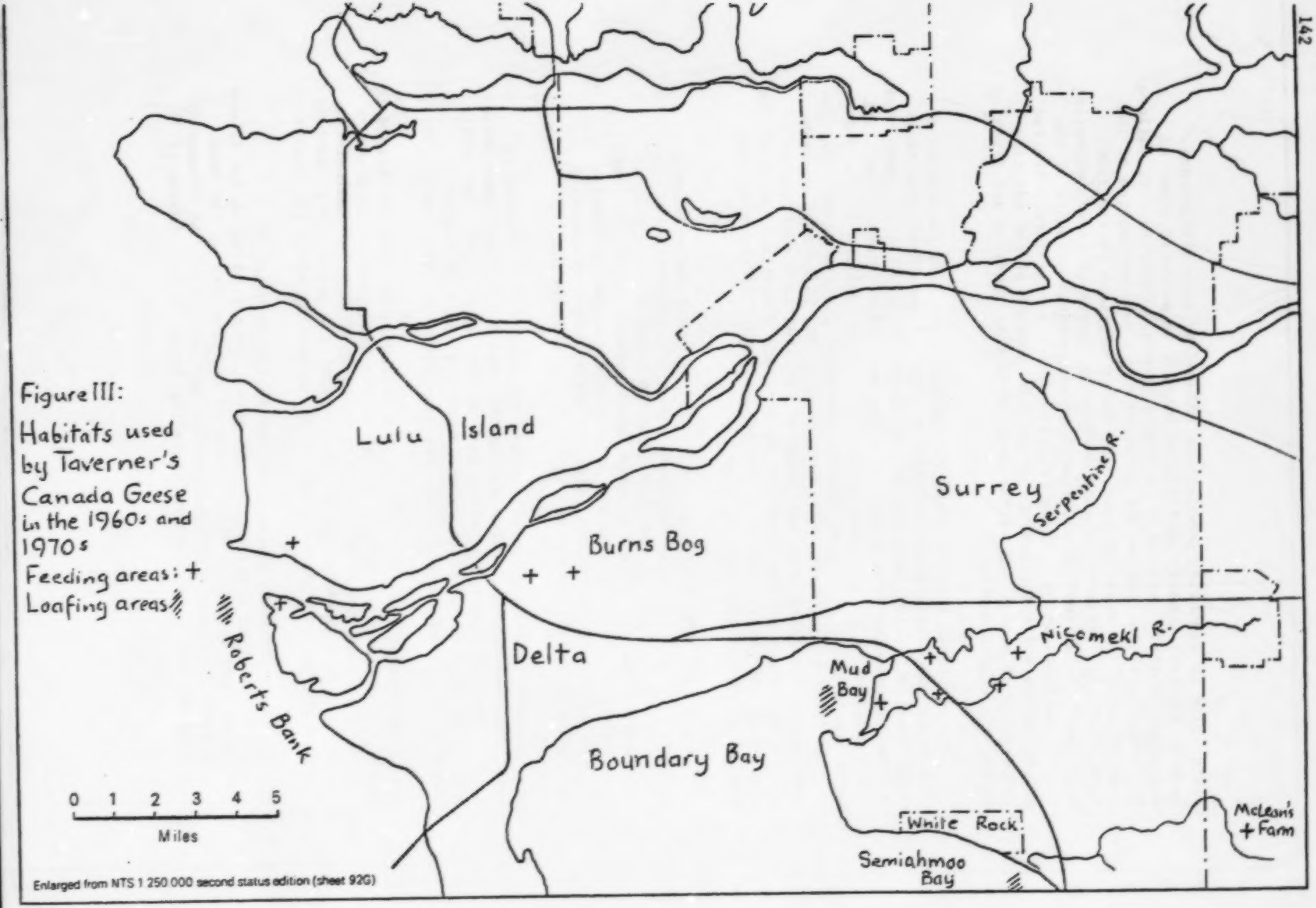

Lulu Island
Burns Bog
Surrey
Serpentine R.
Nicomekl R.
Delta
Mud Bay
Boundary Bay
Roberts Bank
White Rock
Semiahmoo Bay
McLean's Farm
0 1 2 3 4 5
Miles

Figure III: Habitats used by Taverner's Canada Geese in the 1960s and 1970s

Feeding areas: +

Loafing areas: ▨

Enlarged from NTS 1 250 000 second status edition (sheet 92G)

The reluctance of provincial and federal wildlife agencies to manage waterfowl habitats primarily for the maintenance of migratory populations was the result of several factors. Traditionally the management of wildlife in British Columbia had been concerned with the enforcement of regulations matched by an obligation to provide the maximum opportunity for hunting to the licence-paying public. Rapid urban expansion in the lower mainland prompted the belief that since wetland habitat on the lower Fraser was doomed its remaining wildlife should be exploited to the maximum extent practicable (Mair 1977). Illustrative of this attitude was the 1950 agreement to release Ladner Marsh for private development provided that it could be used as a public shooting area for a further two decades. Such pessimism was maintained by the ease with which the fish and wildlife reserve on the crown foreshore was brushed aside to permit the establishment of the deep sea harbour at south Roberts Bank. Even though public attitudes towards environmental management in the lower mainland had undergone a marked change in the 1960's, the provincial government was reluctant to supply the B.C. Fish and Wildlife Branch with adequate funding for a shift towards the acquisition and management of habitat. So in the 1970's, when other private or public agencies provided the Fish and Wildlife Branch with areas of wetland in the lower Fraser valley, their management remained largely dependent upon funds and field assistance from nongovernment organizations, particularly those financed by hunters. It should be noted that the most generous donor of funds for waterfowl habitat management, Ducks Unlimited, has never expressed concern as to whether the lands it works on are open to hunting. The primary concern of this excellent organization is to provide more wetland habitats for waterfowl, and, in so doing, for other wildlife dependent upon wetlands. Such dependence upon the support of hunting organizations plus the belief that hunters were the only element of the public that actually paid for their use of wildlife, tended to make both provincial and federal wildlife agencies unwilling to modify their traditional policy of keeping public hunting opportunities open. This practice was followed even when the demand, as in the case of the Brant, was clearly contrary to the biological needs of the quarry species.

THE PRESENT

Since the late 1960's the studies and plans of the Lower Mainland Regional Planning Board and of the Greater Vancouver Regional District (GVRD) have fostered the conviction that wildlife habitats can be maintained in the wetlands of the lower mainland (Church and Rubin 1970; Halliday and Harris 1972). Hope is also fortified by the belief that most wetlands important to birds and mammals are essential to the maintenance of the Fraser River fisheries. In this new climate government and nongovernment agencies have purchased the following lands to protect them for wildlife:

Location	Status
Reifel Island	Alaksen National Wildlife Area and Reifel Migratory Bird Sanctuary.
Part of Sturgeon Bank	Undesignated
Ladner Marsh	Undesignated
Part of Mud Bay	Closed area
Part of the Chehalis Estuary	Undesignated
Pitt Marsh	Pitt Wildlife Management Area
Addington Marsh	Undesignated
Part of Minnekhada Estate	Regional Park
Burnaby Lake	Regional Park
Boundary Bay (Beach Grove)	Regional Park
Campbell Valley Park	Regional Park

Each of these acquisitions was made by one or more of the following bodies:

- National Agencies
    - Nature Conservancy of Canada
    - National Second Century Fund
    - Canadian Wildlife Service (Environment Canada)

- Provincial Agencies
    - Fish and Wildlife Branch (Ministry of Environment)
    - Greenbelt Fund
    - Provincial Conservation Trust

- Regional Agency
    - Regional Parks Authority

The need to protect farmland has also had benefits for wetland conservation. Early in the 1970's, several farms adjacent to Mud Bay, the Serpentine River, and Boundary Bay were purchased for public ownership as greenbelts. Furthermore, the establishment of the Agricultural Land Reserve has protected large areas of farmland in the Fraser Valley that are puddled or flooded during the winter months and so provide important feeding habitat for dabbling ducks and grazing geese.

Recently the designation "limited use" has been placed by the GVRD on several areas with natural values including Burns Bog and Surrey Bend. While such appellations do not afford protection to these wetlands, they reflect official recognition of their natural values and encourage the hope that such areas will not arbitrarily be alienated by filling and development before alternatives are examined.

It is encouraging also that wetland management has been voluntarily undertaken by various nongovernment agencies including Ducks Unlimited (Canada), the B.C. Waterfowl Society, the Pitt Waterfowl

Management Association, and various clubs associated with the B.C. Wildlife Federation and the Federation of B.C. Naturalists. This has been matched by official recognition of the recreational values of wetlands and waterfowl to the nonhunting public, expressed both in the new provincial Wildlife Act and in the Waterfowl Management Plan for Canada issued by Environment Canada in 1980.

In spite of these encouraging developments, there is still cause for deep concern about the protection and management of wetlands in the lower Fraser valley. The initiative of the GVRD in proposing an open space program as part of its "Livable Region" concept has not been matched by any response from the provincial or federal wildlife management agencies. Nor has the acquisition of wetland habitats by the various public and private agencies been based upon any overall plan giving priority to the biological needs of wildlife. Indeed, human needs, particularly for hunting, continued to receive priority in several habitats recently purchased with public funds.

While the establishment of the Agricultural Land Reserve (ALR) has protected rural lands, it has also shifted pressures for urban development to many lowland areas important as wildlife habitat, especially bogs and swamps deemed unsuitable for agriculture and so excluded from the ALR. The exclusion of such lands from protection under the Agricultural Land Commission Act underlines the need for a form of zoning to conserve selected lands for wildlife.

The validity of setting aside lands for wildlife must be recognized by the general public. But wider public support can only be won by offering broader recreational opportunities than those of the public shooting areas that dominate most of our wetlands. The Waterfowl Management Plan for Canada rightly stresses the need for improvements in the co-operation between public and private wildlife conservation agencies in the management and use of wetlands. In the Fraser Valley this need was well demonstrated by the Canada Goose Propagation Program. In retrospect it is clear that the restoration of the traditional migratory population of Taverner's Canada Geese by the provision and management of suitable habitat as in the Willamette Valley, Oregon would have been preferable to the establishment of a large resident population of feral geese that has aroused hostility towards waterfowl managers in the agricultural community (Institute of Environmental Studies 1980).

Public indifference or even hostility to wildlife management that is directed to a limited area of interest such as hunting will result in scant support for the recommendations of the Area Designation Task Force that are competing with the interests of commerce, industry, and transportation in the Fraser River.

THE FUTURE

The prevention of further wetland losses, not only in the estuary but in the lower mainland as a whole, must be based in part upon acquisition and in part upon zoning or designation, both matched by more intensive management. This will mean purchasing privately owned lands and redesignating important wetlands already in crown ownership. Together such lands should be made part of permanent, staffed, and managed "wildlife management areas" (fig. IV; Institute of Environmental Studies 1980). Purchase of wetlands and waterfowl habitats could be financed by the payment of compensation for the depletion of waterfowl resources resulting from developments elsewhere, and by the sale of Crown lands that provide little or no public benefits, such as many of the scattered "greenbelt" farms that now lie within the ALR. However, greenbelt farms that do have value as wetlands or waterfowl feeding areas, such as those in the Mud-Boundary Bay lowlands, should be incorporated into "wildlife management areas". This does not prevent their continued use as productive farms.

Selected upland marshes, bogs, and swamps should be zoned as conservation areas. Crown foreshore lands embracing intertidal flats and marshes should also be reassigned because their present designations are often insecure and "provide no formal management mandate" (Government of Canada and Province of B.C. 1978).

The management of waterfowl habitat must aim at the maintenance and, where possible, the restoration and enhancement of wetlands and their plant and animal communities. Such management takes two major forms:

1. the manipulation of land and water, and
2. the regulation of human activities on wetlands.

Obviously the restoration of wetlands is most needed in those habitats that have suffered the greatest loss in the past. Marshes, wet grasslands, ponds, and lakes fall into this category in the lower Fraser valley. Current work by Ducks Unlimited (Canada) and the Fish and Wildlife Branch in the Pitt Wildlife Management Area constitutes a first step. The restoration of a wet grassland winter feeding area is clearly feasible in the Mud Bay lowlands and should be given high priority. The peat diggings in Burns Bog have potential as marshes and lakes, especially if the conversion of suitable fringe areas into agricultural land hastens the increase of nutrients in the bog. Indeed, some of the best waterfowl habitats in North Germany and East Anglia are former peat cuttings. Small ponds like those formerly created and maintained by beaver could be established on many streams and in clayey areas of Campbell Valley Park and in other suitable parks.

The restoration of tidal salt marsh has been suggested in parts of Boundary Bay by the removal of driftwood from large areas of shoreline, especially at Grauer Beach. A valuable marsh could be created in Boundary Bay Regional Park by controlling rainwater runoff and raising water levels in the former lagoon now inside the dike.

The enhancement of productivity in wetlands is usually attempted by water-level regulation, by the diversion of nutrient-rich flows to increase the production of desirable food-plants, and by the reshaping

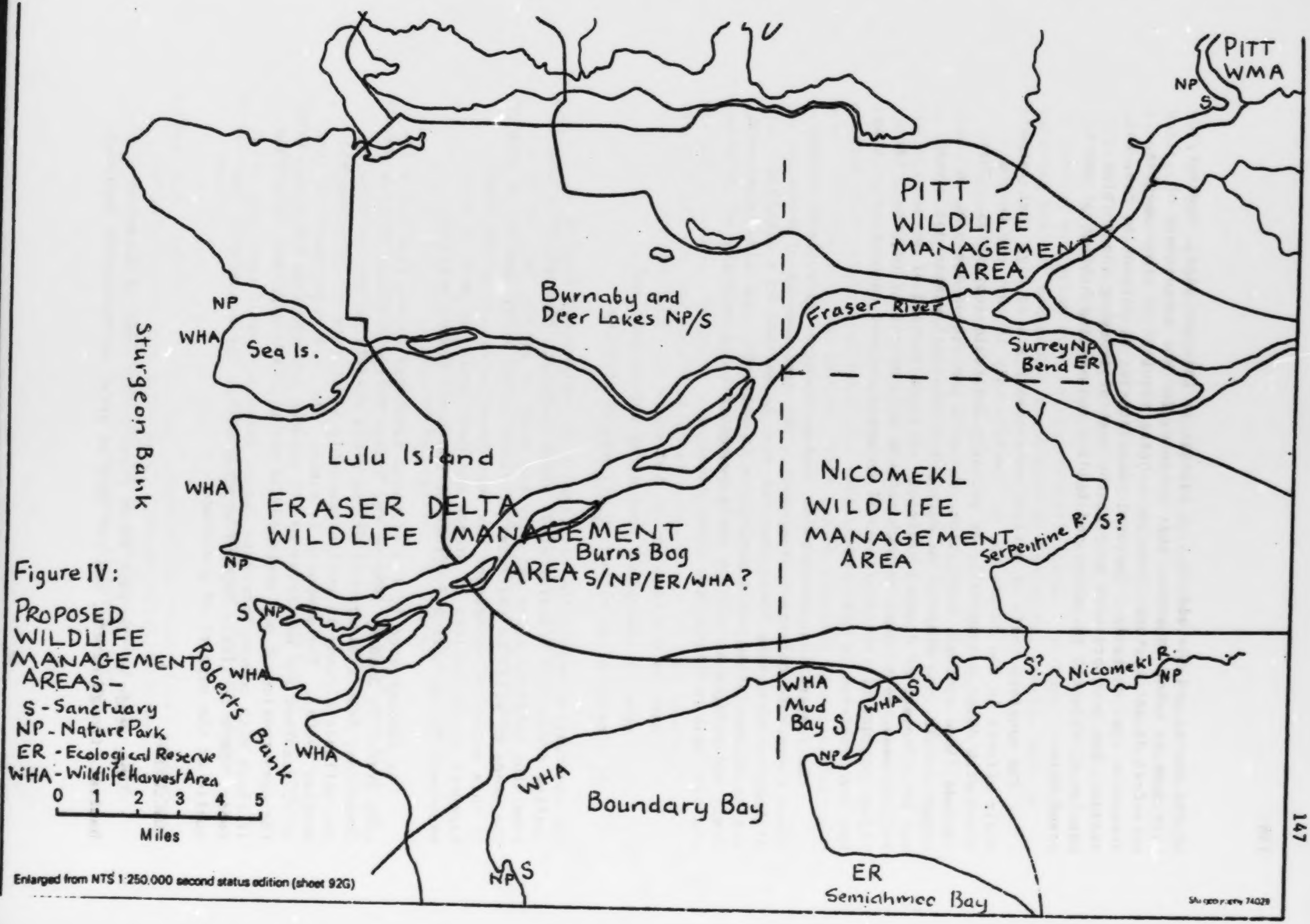

PITT WMA
NP
S
PITT WILDLIFE MANAGEMENT AREA
Burnaby and Deer Lakes NP/S
Fraser River
Surrey Bend NP ER
NP
WHA
Sea Is.
Sturgeon Bank
Lulu Island
WHA
FRASER DELTA WILDLIFE MANAGEMENT AREA
Burns Bog S/NP/ER/WHA?
NICOMEKL WILDLIFE MANAGEMENT AREA
Serpentine R.
S?
NP
S
NP
WHA
Roberts Bank
WHA
S?
Nicomekl R.
NP
WHA
Mud Bay S
WHA
S
NP
WHA
Boundary Bay
NP
S
ER
Semiahmoo Bay
0 1 2 3 4 5
Miles

Figure IV: PROPOSED WILDLIFE MANAGEMENT AREAS -

S - Sanctuary
NP - Nature Park
ER - Ecological Reserve
WHA - Wildlife Harvest Area

Enlarged from NTS 1:250,000 second status edition (sheet 92G) of the shores and the addition of islands to increase edge. However, care must be taken to ensure that measures for the enhancement of waterfowl do not subtract from the habitat required by other species dependent upon wetlands. Improved goose grazing at Serpentine Fen, for example, has been provided only at the cost of reducing the nesting habitat of Wilson's Phalarope and feeding and nesting habitat of Short-eared Owls.

The monetary costs of wetland enhancement are so high that large-scale efforts in the future may be feasible only if they can be combined with other economically or socially desirable activities. These include flood control, irrigation, and soil protection measures on organic soils; the disposal of nutrient-rich animal wastes and sewage; and the disposal of dredged sediments offshore instead of onshore. Wetland management based on such methods will obviously require a far higher measure of interdepartmental co-operation and understanding than has been achieved in the past.

The restoration, enhancement, and maintenance of wetlands cannot alone constitute effective management. The past impacts of human disturbance show that these measures must be matched by a flexible system of regulating human activities on wetlands. Wildlife management areas and refuges across the world demonstrate the validity of dividing the available habitats into three areas:

1. open to hunting;
2. open to controlled nonhunting recreation; and
3. sanctuaries closed to all public activity.

The sanctuaries ensure the maintenance of undisturbed feeding or loafing areas, and breeding areas where relevant, thus ensuring that remaining habitats serve not only the needs of people, but, above all the needs of wildlife (National Wildlife Refuge Study Task Force 1978). If this method of management has been found necessary in the wide expanses of the valleys of Oregon and California, it must be more necessary in the narrow confines of the lower Fraser wetlands.

As demonstrated by the proposal submitted to the Fish and Wildlife Branch in January 1980 by the Fraser Valley Wetlands Habitat Committee, such a management system could readily be applied here on the wetlands already in public ownership (Institute of Environmental Studies 1980a). The proposal is clear. The next requirement is that it be examined and supported by all persons and agencies concerned with the preservation of our wetlands and the wildlife dependent upon them. If those with common interests cannot reach agreement upon this vital topic, there is little hope of winning either the sympathy of the public or the support of government.

CONCLUSION

The study of the past shows firstly that loss of waterfowl habitat, though severe, has not been as great as frequently depicted.

Much of the wetlands of the Fraser floodplain never were good waterfowl habitat. Furthermore, the creation of farmlands subject to seasonal flooding and puddling has, in part, compensated for much loss of marshes. So restoration of depleted wintering populations may be less difficult than is commonly thought. Secondly, too little consideration has been given to disturbance as a factor accounting for the reduction of several wintering species, particularly geese. So human management matching habitat management could have as remarkable results here as elsewhere.

Recent acquisitions of wetland by various agencies and the coincidental protection afforded to farmlands and fish habitats has created an opportunity for the coordinated management of waterfowl habitat by the various agencies involved. In view of the fact that past habitat losses have been less important than previously thought, management should be directed to the restoration of declining or lost species by meeting their biological needs for undisturbed feeding and loafing areas, particularly the latter. This can be achieved by consolidating present land holdings into management units by means of some land purchases, by redesignations and zoning, and by the establishment of field management staffs. Above all, the practical management of human uses of waterfowl habitats should be introduced so that disturbance ceases to be a major factor determining the status of waterfowl on our wetland habitats. Finally, a broader public involvement in the recreational use and appreciation of wetland habitats is essential if we are to win and hold such lands for the future.

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LAND: OUR LIFE, OUR LIVING

CARMEN C. PURDY

President, East Kootenay Wildlife Association

Pressure for land in the Rocky Mountain trench in southeastern British Columbia has steadily increased over the past decade. The B.C. Wildlife Federation and the East Kootenay Wildlife Association have continually insisted that the integrity of the land base be fully protected. It is our view that development of the land base can be carried out in ways that would not cause undue damage to slopes and valley bottoms that support one of the most productive and varied big game populations in North America. We recognize that different land uses have impacts on each other. However, our goal is to ensure that acceptable solutions can be worked out so that the exposure of the southern Rocky Mountain trench to men and their machinery can be managed without undue damage to this unique region and its irreplaceable wildlife resources. We recognize the need to establish acceptable land use priorities, to devise ways in which land use conflicts can be resolved, to consider specific land uses to take advantage of land use zoning, and to set up public involvement which ensures that the bureaucratic machinery to oversee these processes is functioning properly.

During the past ten years, the East Kootenay Wildlife Association has recognized that riparian habitats and big game winter ranges require the greatest degree of protection. As a wildlife association, we no longer focus our attention on such irrelevant issues as deer seasons or cow seasons which occupied so much of our predecessor's time. Habitat is the key; without it, wildlife cannot survive. Riparian habitats are to fish and wildlife what prime agricultural land is to farming, or high-yield forest sites are to forestry. They are the best sites. Indeed, they are critical.

Riparian habitats are tied directly to watersheds and watershed management. Because of the dependence of all industry, all settlement, and all renewable resource industries on watersheds in mountainous regions, watershed management has emerged as the highest priority land use issue. The East Kootenay is a headwater area. It is the source of several major rivers of international significance: the Columbia, Kootenay, Flathead, and their numerous tributaries including the Dutch, Horsethief, Toby, Findlay, White, Bull, St. Mary, Wildhorse, Elk, Fording, Yahk, and Moyie.

To date, development, resource exploitation, and land use planning in the area have been piecemeal. Land designation on crown land includes three relatively large national parks--Kootenay, Yoho, and Glacier--one large wilderness conservancy, the Purcell, and several smaller provincial parks: St. Mary's, Alpine, Mt. Assiniboine, Top-of-the-World, and Elk Lakes. Most of these parks are at high elevations. The majority of midelevation crown lands are or will be designated as provincial forest. Agricultural land reserves and a variety of "reserves against alienation" cover the majority of the crown lands within main valleys. Large areas of crown lands in the Elk, Fording, and Flathead basins are blanketed with coal licences and are being actively explored and mined. Interspersed with crown lands are areas of private land, strategically located to maximize the use of arable soil, mineral, and petroleum resources, settlement values, and the associated crown resources.

The East Kootenay is a hodge-podge of crown and private lands and land tenures. It is the birthplace of grass-roots planning in British Columbia but lacks an overall comprehensive land use plan. This piecemeal planning cannot grapple with the massive developments ongoing and proposed. It is evident that demands now placed on the land and water resources of the area threaten its capability to meet the needs of future generations. In addition to the existing Mica and Libby Reservoirs, Hydroelectric proposals such as the Kootenay Diversion, massive thermal electric generating plants, and other energy projects such as coal gasification threaten the integrity of the remaining land and water and even the air we breathe.

Land developers have found a mecca in the Kootenay Region and particularly in the amenable climate of the Windermere Valley. Lands long past alienated for agriculture, and christmas tree production have been converted into multi-million dollar resorts and subdivisions with emphasis on a real-estate-oriented recreational industry. In the words of one former long-time Windermere valley resident "they're turning the valley into a recreational honkey tonk".

There are two overriding concerns related to the adequacy of land for wildlife. These are the perennial threat that more crown land will be alienated and that land already zoned for nonurban uses will be subdivided or open-pit mined. Recreational amenities and nonrenewable resources are being exploited by individuals and corporations whose land use ethic is overridden by the opportunity to make large profits. The wheels of planning grind slowly while the dammers, the ditchers, and the real estate developers are using up the land base faster each year. Irreplaceable renewable resources are diminishing.

The resolution of land use conflicts must be achieved keeping in mind that both renewable and nonrenewable resources will be used. Solutions are not unattainable. We do not need new ideas as we already have a bagfull. What is required is a commitment from government to land use planning in the East Kootenay and elsewhere in British Columbia that will meet the following principles. Firstly, no further alienations of crown land for any purpose should occur until a comprehensive plan has been developed similar to the land use plans developed by the Progressive Conservative government of Alberta on the eastern slopes of the Rocky Mountains. Secondly, an overall land use plan must be created covering all jurisdictions and all resources, both renewable and nonrenewable. Thirdly, an environment conservation authority needs to be established to maintain a nonadministrative overview of land use guidelines and decisions and to make recommendations directly to the chairman of the Environment and Land Use Committee regarding zoning and land use conflicts.

In the past we have been told: "Write to your MLA". Well, we finally learned to write and write we did: telegrams, telephone conversations, briefs, the works. While this has had some impacts, and we do not intend to let up, the desired result has not been achieved. Lacking a comprehensive plan and living in a complex, multilayered society, there are far too many events to keep astride of all of the conflicting changes. Those of you who are now wringing your hands after the presentations today will again ask: "What can I do?" Many of you are already involved but to those of you who are not, I urge you to seriously consider running for politics. If that scares you examine the alternatives. A city alderman, particularly those in our smaller communities, can have considerable influence over the direction of land use zoning and planning by sitting on standing committees and regional boards. If developers can dominate a council, why not conservationists? Another alternative is to represent your organization on one of the many public involvement committees established in the province. Lobby your local politicians. Do not stop at your MLA; aldermen, regional district board members, and members of Parliament also have an influence on the land. Take a politician to lunch.

Land is our life and living. We all owe a debt to mother earth. How will you repay her?

BRITISH COLUMBIA: VALLEY BOTTOMS AND MOUNTAIN TOPS

R.A. DEMARCHI

Regional Wildlife Biologist, Fish and Wildlife Branch,
Ministry of Environment, Cranbrook, B.C.

Although I am not a believer of astrology, occasionally I read my horoscope. I did so on the day that I started to write this speech. It read: (1) "you may feel the need to work in seclusion" (the phone never stopped ringing), (2) "travel is part of the picture" (here I am in sunny downtown Burnaby) and (3) "new ideas are more productive than old ones". The question was, should I recycle some of my old speeches or try to develop a new theme? Falling back on a fortune cookie adage, "there is nothing new under the sun", I decided to deliver the same message that I have been expounding for years. British Columbia is long on mountains and short on valley bottoms. What I hope to accomplish in 15 minutes is to determine where we are going with wildlife conservation in B.C. Firstly, however, we should look at where we have come from and where we are.

British Columbia has a short settlement and development history. As a province we are only 110 years old. Our motherland, England, had no great regard for her Pacific colonies. They were considered to be remote, wild, and virtually worthless and exclusive trading rights west of the Rockies were granted to a single entity--the Hudson Bay Company. All of B.C. was wildlife habitat when Alexander MacKenzie, David Thompson, and Simon Fraser roamed them thar' hills. In fact, for the first 75 years or so of our history, wildlife--specifically fur--was the dominant resource.

The Hudson's Bay Company whose licence was cancelled in 1858, had no concern for organized settlement or development of the region. Creating a policy for the disposal of public lands where ownership had to be reconciled with water, timber, and grazing rights, with mineral claims, and with the need for agricultural development was both complicated and difficult. Basic inventory data and accurate maps were virtually nonexistent. Despite these obstacles, Sir James Douglas, governor of both Vancouver Island and British Columbia enacted land and resource legislation between 1858 and 1864 which directed the course of settlement and development in British Columbia to the present day.

Douglas forged a policy which encouraged settlement and curbed speculation in land, water, forests, and minerals (Cail 1974).

Among the significant policies developed by Douglas and maintained to this day were the abandonment of British Common Law relating to riparian rights in water and the retention of all minerals in right of the crown provincial. Little foresight was shown in the area of forest land. However, forests had virtually no value and until at least 1900 were looked upon by the early settlers as more of an obstacle to progress than an asset. Therefore, despite the fact that even the best forest land could be purchased in 1861 for four shillings, two pence per acre, the amount of forest land alienated by public sale (about one-million acres) was minimal compared to the wholesale alienation of 4/5ths of the timber land in the U.S. under the Timber and Stone Act (Flummerfelt 1914-1917). After 1905, when timber stands were opened to licencees, the demand was so great that the McBride government decided to place all unalienated timber stands under government reserve where, for the most part, they have remained ever since (Cail 1974).

Alienation of land has been primarily for agricultural and residential purposes. Thus, although most prime agricultural land in southern B.C. had been alienated by 1910, the provincial forests, water, fish, wildlife, and mineral resources remained largely in public ownership.

Administration of land and resources and enforcement of provincial statutes were financed almost entirely through revenues from land sales and resource royalites. In view of the constant budgetary deficits experienced by every provincial government until 1905, British Columbians should be thankful that more public lands and natural resources were not permanently alienated than was the case by the early 1900's.

The vastness of British Columbia encouraged the feeling that the province's land and resources were inexhaustible. It is only recently that the public has come to realize that economically arable land is severely limited and that other natural resources are widely distributed over difficult mountainous terrain (Margaret Ormsby, in Cail 1974). The myth of super abundance is gradually disappearing from our thinking.

In describing the Lower Mainland, the Lower Mainland Planning Board stated (B.C. Natural Resource Conference 1964):

> The region is land poor. Its stock of usable land is very small - less than 800 square miles or about one fifth of one percent of the area of British Columbia. On this tiny enclave, surrounded by mountains, sea and an international boundary there are already more people, per square mile, overall, than there are in Holland, the most densely populated country in Europe: 1070 people per square mile here; 905 in Holland . . .

> Yet the region's population will continue to grow. About a third of a million people will be added every decade - roughly 100 per day - until by the end of the century there will be 2.2 million people in the region . . .. As a result, the pressure on land will rise tremendously.
>
> This does not imply a scarcity of land for building on. It means a generally limited supply for all purposes - living, working, raising crops, and playing - and it stresses the need to use the region's land resources thoughtfully, with an eye to tomorrow as well as today.

That was written almost 20 years ago and described conditions as they existed in the early 1960's. The predictions were accurate as most of you know.

Having run out of land to alienate and develop in southern B.C. we developed a northern vision. Successive governments have periodically promoted the sale of lands to expand agricultural development, the most significant occurring in central and northern B.C. in the mid-1960's to the early-1970's. Despite these alienations, nearly 95-percent of the provinces' land and water surface remains in public ownership. The recent furor over the province's land alienation program is testimony to the strong attachment that British Columbian's have to the public domain. This attachment has grown out of an appreciation for the benefits and enjoyment to be gained by all British Columbians from the availability of expansive tracts of public land. Indeed our major industries are dependent upon these lands for their existence.

In 1964, the Fifteenth Natural Resource Conference set out, in detail, an inventory of the primary natural resources of the province. It was, to my knowledge, the most recent attempt to produce a comprehensive resource catalogue for the entire province. Each chapter deals with a different resource but each resource is dealt with separately. No attempt was made to integrate the various interdependent and competing resources and none has been made to date (B.C. Natural Resource Conference 1964).

For the past two decades to the present, despite the rhetoric about multiple use, integrated resource management, and cooperation between individual resource interests, each sector has planned for its own separate goals. Some examples: British Columbia Hydro and Power Authority pursues the construction of energy generating and transmission facilities to meet absolute public demand at the worst possible generating circumstance and the least cost; the Ministry of Agriculture and Food seeks 65-percent selfsufficiency in food production; Federal Fisheries and Oceans intends to double salmon production; the Ministry of Forests foresees a serious fall-down in timber production and must initiate intensive forest management to dampen the shortfall; the Ministry of Lands, Parks and Housing, responding partly to the Ministry of Agriculture and Food's goal to produce more food and partly out of demand projections for urban land initiates a program to alienate more crown land; the Ministry of Industry and Small Business seeks foreign markets for coal and the Ministry of Tourism attempts to entice more visitors to vacation in "Super Natural" B.C. The Fish and Wildlife Branch of the Ministry of Environment has also caught on to the "meet the demand" process. We are now developing demand projections which reveal serious shortfalls in the supply of fish and big game by 1990 and are developing plans to attempt to meet those shortfalls.

Coordinated resource management planning has made a significant contribution to the management of renewable resources in most interior regions. However, even this level of planning is absent from coastal regions and the province still lacks a comprehensive land use plan. Indeed, for coordinated resource management plans to have any security they must be conducted on areas where major land use decisions have already been made.

If we are to retain the remaining options which have been protected throughout our history, and if we are to achieve the optimum sustained yield of resources, British Columbia must rapidly enter into an era of enlightened land use planning. Our most productive land is in the limited low-elevation valley bottoms and plateaus. As has been repeated many times, it is here that the biggest and best trees grow, where the greatest diversity and abundance of wildlife occurs, and where our salmon and trout spawn and rear. It is also here that most land alienations have occurred, where we grow our most productive and economical crops, where more than 90-percent of British Columbians live, and where we build our factories, highways, railroads, and our utility corridors. As we urbanize and industrialize our best farmland, we are forced to alienate and farm our best timber sites and as these high-capability forest lands are cleared for farming, we must intensify forestry on our best wildlife and fisheries habitats and expand logging into sensitive watersheds and high-elevation wilderness areas. In addition we flood the midelevation valleys and plateaus to meet the demand for electrical energy and open pit mine our coal for export placing additional stress on all resources, both renewable and non-renewable.

Instead of establishing a policy of best land use we are forcing ourselves into practicing second and third best land use. Apart from the serious problems facing twenty or so species of tree-cavity-dependent birds and mammals in old growth interior and coastal Douglas-fir forests, and specific localized problems, there is no crisis per se facing B.C. wildlife. But that should not be cause for complacency. Wildlife is a valuable asset, one that has never been given the recognition or the attention that it deserves. Should wildlife be given priority status only on lands that are of no significant value to other land users? Should wildlife be accommodated only when other land uses are not impaired? Should wildlife managers be forced to rationalize the values of wildlife and public wildlife interest groups be forced to lobby for wildlife in the case of each and every application for land or resources? I think not. But too often this is the case. Our energies are dissipated by the tyranny of small decisions. The alternative is land use planning and zoning. We must devise a system of priorizing land uses which (1) recognizes all resources including wildlife, (2) is based on land capability, public demand, and both tangible and intangible values, (3) takes into account the renewability and the compatibility of various land uses and (4) builds conservation of energy and resources into the equation. We still have a choice in British Columbia, perhaps with a greater range of options than any other province or state in North America. The choice is obvious; will we be managing and enjoying wildlife in our productive valley bottoms or scratching around on the unproductive mountain tops. The answer will depend upon the success of land use planning in British Columbia over the next decade.

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STRATEGIC WILDLIFE HABITAT PLANNING

ACCOUNTING FOR WILDLIFE HABITATS IN MANAGED FORESTS

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Introduction

The following discussion uses the Blue Mountains as the locale but the illustrative details are not so important as the procedures and the application of principles that are illustrated. Before wildlife and forestry professionals can work together to simultaneously provide wildlife and wood products from a managed forest they must develop a framework or a system of analyses and understanding. What follows is one way to do just that.

So, do not dwell on the details. Rather, consider the approach and the process. At the end the potential user must determine if there is merit and usefulness in the process considering the current status of forestry and wildlife in your country.

This paper was formed from other papers and is covered in detail in the book, Wildlife Habitats in Managed Forests: the Blue Mountains of Oregon and Washington (Thomas 1979). Much of this paper is taken verbatim from Thomas et al.'s (1980) presentation to the Society of American Foresters' meeting in Boston, Massachusetts, USA, and is used here with that society's permission.

Wildlife as a Product of Forest Management

Until recently, most forest managers were not especially concerned with wildlife. The law did not require it. The public did not demand it. Politics did not compel it.

Times, laws, public demands, and politics have changed. Forests are ever more intensively managed to meet burgeoning demands for wood, water, recreation, grazing and wildlife. Forest managers eventually must be able to account for all wildlife, particularly in land-use planning. However, knowledge necessary to make a perfect analysis of forest management impacts on wildlife habitat does not exist and never will. But more knowledge is available than has been used. It must be organized to make sense, biologically and silviculturally. Standard practice has been to manage one species or a limited number of species. But we have been unable to evaluate the impacts of management on all wildlife.

How do forest managers affect wildlife? They do not manage wildlife directly. They manage habitat with every decision and can relate to, understand, control, and be held accountable for habitat. Habitat maintenance is basic to all wildlife management and the key to organizing wildlife knowledge for forest management.

The world's forests are managed primarily for timber production and, in some countries, for other multiple uses. Timber harvesting and roadbuilding alter wildlife habitat more than any other activity.

The setting for this paper is the Blue Mountains of Oregon and Washington. The concepts, principles, and practices, however, are, I believe, applicable to forest management anywhere.

Timber and wildlife habitat management are more or less compatible if wildlife needs are recognized along with requirements for timber management. Such compatibility can be realized by better understanding plant and animal communities, their changes over time, and responses to silvicultural practices.

Forest management is the manipulating of forest environments to produce products desired by the owners. This mix changes with time, economic conditions, public demand, legislation, and capability of the land.

Wildlife habitat management in forests must be carried out in coordination with the dominant land management activity--timber management. Timber management _is_ wildlife management. The degree to which it is _good_ depends on how well biologists describe wildlife needs and how well foresters manipulate habitat to achieve wildlife goals. Timber management is, potentially, the most practical way to achieve wildlife habitat goals in managed forests.

Wildlife Management Goals

Wildlife management is the art of manipulating habitat to enhance conditions for selected species, manipulating animals to achieve desired ends, or both. There are two production goals: species richness and featured-species.

Management for species richness which insures that most wildlife species are maintained in viable numbers is achieved by providing a spectrum of habitat conditions. Characteristic stages of each plant community should be representative of the vegetative mosaic. We must know each species habitat and incorporate them into guides to protect forest integrity, stability, and diversity.

Featured-species management produces selected species in desired numbers, in specific locations, for specific reasons, and is achieved by manipulating habitats to ease or remove limiting factors.

No single system is a panacea for wildlife. Which system to use must be decided on management goals. The required forest structure must be considered, along with stand size and shape, juxtaposition to other stands, road systems, and special habitat needs. Flexibility in using silvicultural systems can help meet wildlife goals.

The "compleat forester" must account for impacts--good or bad--of management activities on all wildlife. Legal challenges, reviews, and court opinions emerging from conflicts over forest management, raise questions to which managers have inadequate answers. For example, to what degree will species be adversely influenced, benefited, and or unaffected by management? Will influences vary over time? Which impacts are irreversible? Which can be reduced? Which species are sensitive to habitat change? How will they respond? Which species are threatened or endangered? How will they be influenced? Our process can provide answers by handling wildlife habitat information in a way that makes sense to a manager.

Wildlife Habitat Relationships

We assembled pertinent data on the 378 vertebrate species. Problems arose such as how to "fill in the blanks" when information was inadequate and how to present detailed information without overwhelming users. We weighed timber management impacts on wildlife, considered habitat as the prime determinant of wildlife welfare, and associated wildlife with habitats.

Habitats, to be considered in timber management activities, were identified by equating plant communities and successional stages to habitats. Successional stages result from plant community development and are roughly analogous to stand conditions. These stages are altered by management such as shrub control, planting trees or grasses, and thinning stands. Conditions produced differ from the natural, but the resulting structure is similar to successional stages. By associating species and groups of species with communities and stages, a manager can translate standard inventories into wildlife habitat data. Communities and stages have unique environmental conditions important to wildlife (fig. 1).

Interactions of site and plant community structure could be dissected, and influences on the animal community determined. If such information existed, it would be too complex for ready use.

A plant community is considered to be the integrator of factors acting on a site. Wildlife species are adapted to plant communities and stages for feeding, or reproduction, or both. This provides four levels of information from which the following displays were developed. Detail increases by level. The displays were constructed from:

	Successional stages					
Environmental variable	Grass-forb	Shrub-seedling	Pole-sapling	Young	Mature	Old growth
Plant diversity	●●	●●●●●	●●●	●	●●	●●●
Vegetation height		●	●●	●●●	●●●●	●●●●●
Canopy volume		●	●●	●●●	●●●●●	●●●●
Canopy closure	●	●●	●●●●	●●●●	●●●●	●●●
Structural diversity	●	●●●●	●	●	●●	●●●●●
Forage production	●●●●●	●●●	●	●	●●	●●●
Browse production	●	●●●●●	●	●	●●	●●●
Animal diversity	●●●	●●●●	●	●●	●●●●●	●●●●

Figure 1. Forest successional stages and related environmental conditions

interpretation and extrapolation of literature information and consensus of biologists.

Level 1 shows life form (groups of species exhibiting similar habitat requirements), relationships to plant communities, and stages for feeding and reproduction. Level 2 details relationships of individual species to plant communities and stages for feeding and reproduction. Level 3 summarizes available biological data by species. Level 4 gives selected species references to provide detailed data and additional information sources. Level 2 was used to develop the vulnerability of each species to habitat manipulation.

Large numbers of species are difficult to account for in planning. We reduced 378 species to 16 life forms (table 1). Adapted from Haapanen's (1965) division of Finnish forest birds into groups, based on habitat requirements, the concept was expanded to include terrestrial vertebrates.

Plant community alterations, man-made or natural, can be pictured either as a change in a community or as advancing or retarding succession (table 2). Responses of life forms to plant communities and stages can be generalized through the response of each species (level 2). Species, grouped by life form, facilitate comparison with level 1 information. Orientation of species, within life forms, to plant communities is illustrated for life form 13 in table 3. Information on the orientation of species in life form 13 to successional stages is illustrated in table 4.

TABLE 1. Life form descriptions

Life form	Reproduces	Feeds	No. of species[1]	Examples
1	in water	in water	1	bullfrog
2	in water	on the ground, in bushes, and/or in trees	9	long-toed salamander, western toad, Pacific treefrog
3	on the ground around water	on the ground, and in bushes, trees, and water	45	common garter snake, killdeer, western jumping mouse
4	in cliffs, caves, rimrock, and/or talus	on the ground or in the air	32	side-blotched lizard, common raven, pika
5	on the ground without specific water, cliff, rimrock, or talus association	on the ground	48	western fence lizard, dark-eyed junco, elk
6	on the ground	in bushes, trees, or the air	7	common nighthawk, Lincoln's sparrow, porcupine
7	in bushes	on the ground, in water, or the air	30	American robin, Swainson's thrush, chipping sparrow
8	in bushes	in trees, bushes, or the air	6	dusky flycatcher, yellow-breasted chat, American goldfinch
9	primarily in deciduous trees	in trees, bushes, or the air	4	cedar waxwing, northern oriole, house finch
10	primarily in conifers	in trees, bushes, or the air	14	golden-crowned kinglet, yellow rumped warbler, red squirrel
11	in conifers or deciduous trees	in trees, in bushes, on the ground, or in the air	24	goshawk, evening grosbeak, hoary bat
12	on very thick branches	on the ground or in water	7	great blue heron, red-tailed hawk, great horned owl
13	in own hole excavated in tree	in trees, in bushes, on the ground, or in the air	13	common flicker, pileated woodpecker, red-breasted nuthatch
14	in a hole made by another species or in a natural hole	on the ground, in water, or the air	37	wood duck, American kestrel, northern flying squirrel
15	in a burrow underground	on the ground or under it	40	rubber boa, burrowing owl, Columbian ground squirrel
16	in a burrow underground	in the air or in the water	10	bank swallow, muskrat, river otter
		Total	327	

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[1] Species assignment to life form is based on predominant habitat-use patterns.

Table 2. Anticipated changes in successional stage or condition because of some management activities

Management action	Grass-forb	Shrub-seedling	Pole-sapling	Young	Mature	Old growth
Shrub control:						
• Herbicides	▶	▶	▶	◀	◀	◀
• Mechanical control	◀	◀	NA	◀	◀	◀
Controlled burn:						
• Cold burn	◀	◀	▶	▶	◀	◀
• Hot burn	◀	◀	◀	◀	◀	◀
Fertilization	◀	▶	▶	▶	▶	○
Planting:						
• Trees	▶	▶	NA	NA	▶	▶
• Shrubs	▶	◀	NA	NA	NA	NA
Regeneration cut:						
• Clearcut	NA	NA	NA	◀	◀	◀
• Shelterwood	NA	NA	NA	▶	◀	◀
Salvage	NA	NA	◀	◀	◀	◀
Thinning (including single tree selection harvest)	NA	▶	▶	▶	▶	○
	Successional stage condition					

▶ advances succession
◀ retards succession
○ no effect on succession
NA not applicable

Table 3. Orientation of wildlife species in life form 13 to plant communities

● Reproduction and feeding R Reproduction only F Feeding only

SPECIES	Special habitats (components)																				Unique habitats			Number of habitats used by each species for:	
								Marshes							Edges (ecotones)										
BIRDS	Rivers	Streams	Sloughs	Lakes	Reservoirs ≥0.8 ha (≥2 acres)	Reservoirs <0.8 ha (<2 acres)	Intermittent ponds	Large ≥0.8 ha (≥2 acres)	Small <0.8 ha (<2 acres)	Rush, cattail	Sedge	Deciduous vegetation	Standing or slow-running water	Fast-running water	Grass-shrub	Shrub-forest	Grass-forest	Snags	Logs	Burrows	Cliffs, rimrock	Talus	Caves	Reproduction	Feeding
common flicker	●	●	●	●	●	●		●	●			●				F	F	●	F					10	13
pileated woodpecker	●	●		●	●													●	F					5	6
Lewis' woodpecker	●	●	●	●	●			●	●			●				●	●	●	F					11	12
yellow-bellied sapsucker	●	●	●	●	●	●		●	●			●				●		●						11	11
Williamson's sapsucker	●	●				●		F	F			F				F	F	●						4	9
hairy woodpecker	F	F		F	F	F		F	F			F				F	F	●	F					1	12
downy woodpecker	●	●	●	●	●	●		●	●			●				F	F	●	F					10	13
white-headed woodpecker																		●						1	1
black-backed three-toed woodpecker																F	F	●	F					1	4
northern three-toed woodpecker																		●	F					1	2
white-breasted nuthatch																F	F	●	F					1	4
red-breasted nuthatch	F	F			F	F										F	F	●	F					1	8
pygmy nuthatch	F	F			F	F										F	F	●						1	7
Number of species using each habitat for:																									
Reproduction	6	6	4	5	5	4	0	4	4	0	0	4	0	0	0	2	1	13	0	0	0	0	0		
Feeding	9	9	4	6	8	7	0	6	6	0	0	6	0	0	0	10	9	13	9	0	0	0	0		

Table 4. Orientation of wildlife species in life form 13 to successional stages

• Reproduction and feeding R Reproduction only F Feeding only

Species		Grass-forb	Shrub-seedling (0-10 years)	Pole-sapling (11-39 years)	Young (40-79 years)	Mature (80-159 years)	Old growth (160 + years)	No of successional stages used: Repro-duction	No of successional stages used: Feeding
BIRDS									
common flicker		F	F	F	•	•	•	3	6
pileated woodpecker						•	•	2	2
Lewis' woodpecker		F	F		•	•	•	3	5
yellow-bellied sapsucker					•	•		2	2
Williamson's sapsucker						•	•	2	2
hairy woodpecker					•	•	•	3	3
downy woodpecker					•	•	•	3	3
white-headed woodpecker						•	•	2	2
black-backed three-toed woodpecker					•	•	•	3	3
northern three-toed woodpecker					•	•	•	3	3
white-breasted nuthatch						•	•	2	2
red-breasted nuthatch					•	•	•	3	3
pygmy nuthatch						•	•	2	2
No of species using successional stage	Reproduction	0	0	0	8	13	12		
	Feeding	2	2	1	8	13	12		

Wildlife have requirements other than plant community and stage. Orientations to special and unique habitat components are illustrated for life form 13 in table 5.

Level 2 has a variety of uses. For example, the importance of each community and stage can be evaluated by its ability to provide habitat for different species. In each planning scenario, impacts of proposed actions on wildlife--individual species or all species--can be examined.

Some communities support more wildlife species than others (fig. 2). Later stages of forest succession (mixed conifer in this example) are important to more species than earlier stages (fig. 3). Habitat for reproduction is more restrictive than that for feeding.

The generalized relationship of wildlife to stages of forested communities (fig. 4) promotes concern about effects of intensive timber management on wildlife diversity and on welfare of species narrowly adapted to specific stages, particularly grass-forb, shrub-seedling, and old-growth.

Table 5. Orientation of wildlife species in life form 13 to special and unique habitats

● Reproduction and feeding R Reproduction only F Feeding only

Species	Dry meadows	Moist meadows	Other grasses	Sagebrush-bitterbrush	Other shrubs	Curlleaf mountain-mahogany	Western juniper	Quaking aspen	Riparian (deciduous)	Ponderosa pine	Mixed conifer	White fir (grand fir)	Lodgepole pine	Subalpine fir	Alpine meadows	Number of plant communities used by each species for: Reproduction	Number of plant communities used by each species for: Feeding
BIRDS																	
common flicker							●	●	●	●	●	●				6	6
pileated woodpecker										●	●	●				3	3
Lewis' woodpecker									●	●	●					3	3
yellow-bellied sapsucker								●	●							2	2
Williamson's sapsucker										●	●	●		●		4	4
hairy woodpecker										●	●	●	●	●		5	5
downy woodpecker								●	●							2	2
white-headed woodpecker										●	●					2	2
black-backed three-toed woodpecker											●	●	●	●		4	4
northern three-toed woodpecker													●	●		2	2
white-breasted nuthatch										●	●					2	2
red-breasted nuthatch											●	●	●			3	3
pygmy nuthatch								F		●	F					1	3
No. of species using each community: Reproduction	0	0	0	0	0	0	1	3	4	8	9	6	4	4	0		
No. of species using each community: Feeding	0	0	0	0	0	0	1	4	4	8	10	6	4	4	0		

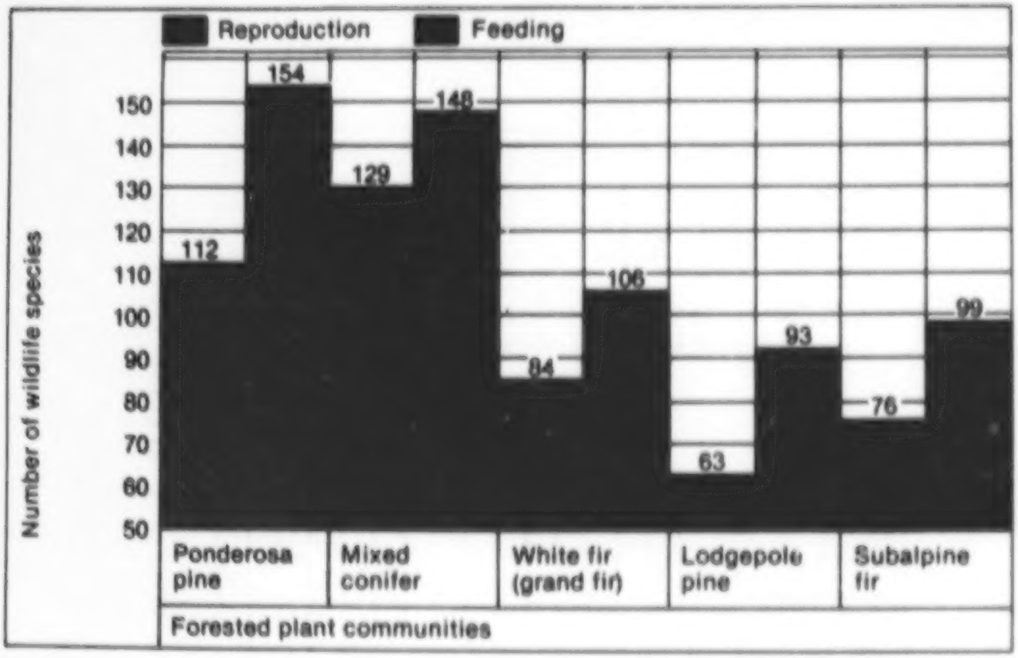


Figure 2. Number of wildlife species oriented to forested plant communities for feeding and reproduction

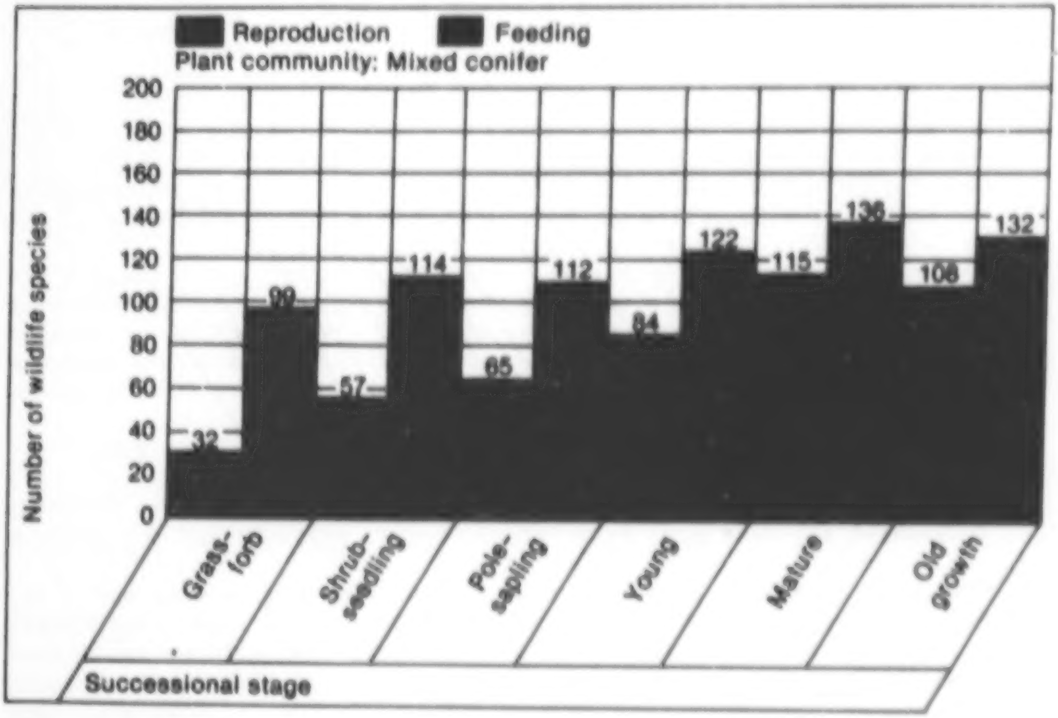


Figure 3. Number of wildlife species associated with successional stages in the mixed conifer community

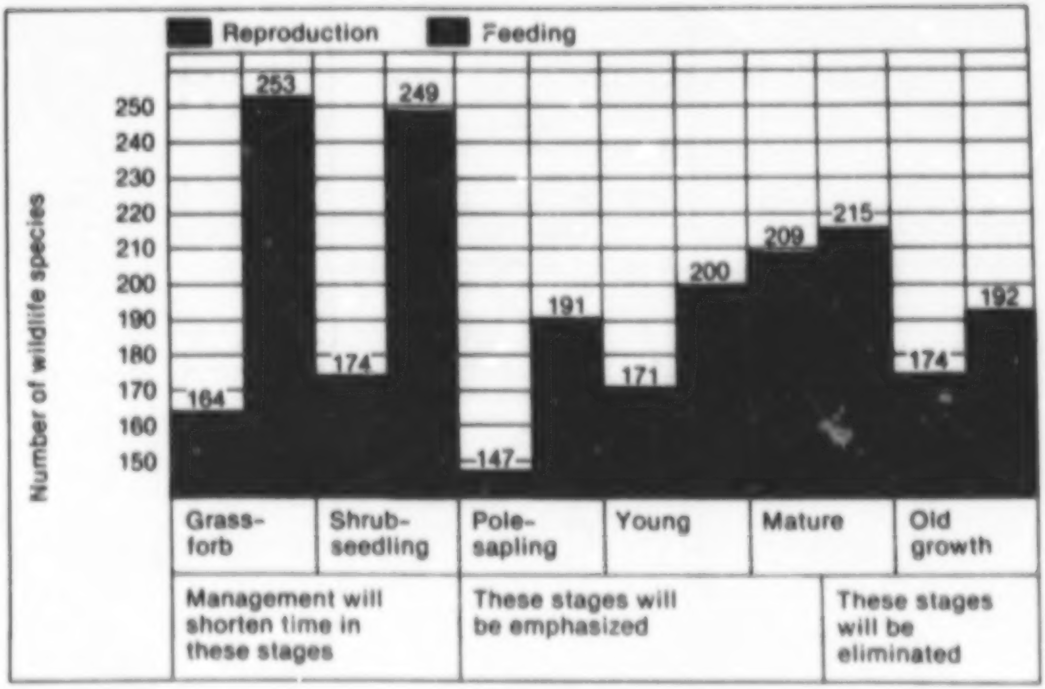


Figure 4. Number of wildlife species oriented to forest successional stages and the potential effect of intensive timber management

Level 3 summarizes information on each species. Life form 13 (table 6) is an example. If information is not sufficient, references are listed for each species. Literature cited sections may provide useful leads to additional information.

Versatility Index

Each species exhibits varying versatility (adaptability) in the number of communities and stages used for feeding and reproduction. Sensitivity to change is related to versatility. The most versatile are the least sensitive to habitat manipulation and vice versa.

Such data (tables 3 and 4) were used to develop versatility scores (V score). Collectively, they provide an index to the versatility of all species. V scores (table 7) were determined by the number of plant communities and stages to which a species showed orientation for feeding and reproduction using the following equation:

$$V = (C_r + S_r) + (C_f + S_f);$$

where C_r is the communities used for reproduction, S_r the number of stages used for reproduction, C_f the number of communities used for feeding, and S_f the number of stages used for feeding.

Rare or threatened species were also identified (table 8).

Table 6. Key information on some species in life form 13

Species	Versatility rating[2]	Activity; seasonal occurrence												Reproductive capacity; potential per year	Home range (h.r.) or territory size (terr.)[3]
		January	February	March	April	May	June	July	August	September	October	November	December		
BIRDS															
common flicker	M	■	■	■	■	▨ ■	▨ ■	▨ ■	■	■	■	■	■	5-10	terr. 16.2 ha (40 acres)/pair
pileated woodpecker	L	■	■	■	▨ ■	▨ ■	▨ ■	▨ ■	■	■	■	■	■	3-5	terr. 121 ha (300 acres)/pair
Lewis' woodpecker	L			■	■	▨ ■	▨ ■	▨ ■	■	■	■			6-8	terr. 6.1 ha (15 acres)/pair

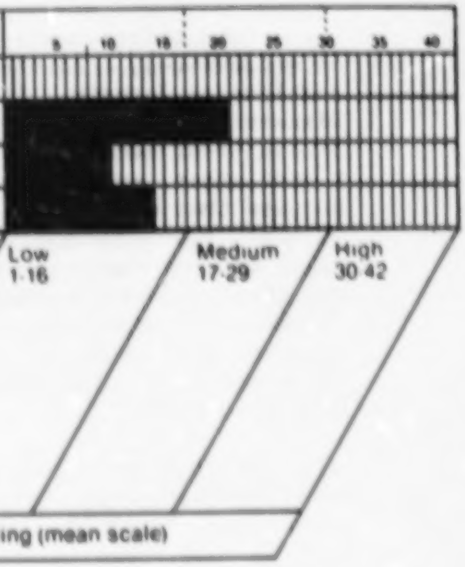
Species	Plant community groups (habitats)[4]														Special habitats (components)[6]									Unique habitats[6]		
															Riparian zones											
	Dry meadow	Moist meadow	Other grasses	Sagebrush–bitterbrush	Other shrubs	Curlleaf mountainmahogany	Western juniper	Quaking aspen	Ponderosa pine	Mixed conifer	White fir (grand fir)[5]	Lodgepole pine	Subalpine fir	Alpine meadow	Rivers, creeks, streams	Lakes, reservoirs, ponds	Marshes, bogs, swamps	Standing, slow-running water	Fast-running water	Edges (ecotones)	Snags[7]	Logs[8]	Burrows	Cliffs, rimrock	Talus	Caves
BIRDS																										
common flicker	□	□	□	□	□	□	● ■	● ■	● ■	● ■	● ■	○ □	○ □	□	● ■	● ■	● ■			■	● ■	■				
pileated woodpecker									● ■	● ■	● ■	□	□		○ □	○ □					● ■	■				
Lewis' woodpecker		□	□		□			□	● ■	● ■					● ■	● ■	● ■			● ■	● ■	■				

L Low; M Medium; H High ▨ Reproductive activity ■ Feeding activity

Reproduction: ● Primary (≥40%); ○ Secondary (<40%) Feeding: ■ Primary (≥40%); □ Secondary (<40%)

Table 7. Versatility ratings for some wildlife species in life form 13

Species	1 Reproductive orientation: No. of plant communities used	2 Reproductive orientation: No. of successional stages used	3 Reproductive orientation: Columns 1 + 2	4 Feeding orientation: No. of plant communities used	5 Feeding orientation: No. of successional stages used	6 Feeding orientation: Columns 4 + 5	7 Versatility score: columns 3 + 6
BIRDS							
common flicker	6	3	9	6	6	12	21
pileated woodpecker	3	2	5	3	2	5	10
Lewis' woodpecker	3	3	6	3	5	8	14



Versatility rating (mean scale)

Table 8. An example of some species in the Blue Mountains that are of special interest because of their potentially threatened or endangered status

Life form	Species	1 Federal Register (endangered)	2 Oregon State (endangered or threatened)	3 U.S. Dep. Inter. Fish & Wildl. Serv. "Red Book"	4 USDA FS RNA "Yellow Book"	5 OSU endangered plants & animals of Oregon	6 Audubon—Blue list for 1976	7 USDA FS R-6	8 Threatened wildlife of Idaho
12	osprey			SU	SI	R	X	U	SU
4	prairie falcon			T	SI	R	X	R	T
4	peregrine	E	E	T	SI	E		E	T

E-Endangered
P-Peripheral
R-Rare
SI-Species of special interest
SU-Status undetermined
T-Threatened
U-Unique
X-Occurs on list

Data Base for Planners

The system has been used to prepare land-use plans, environmental impact statements, and environmental analysis reports, enabling users to produce more comprehensive, accurate results in less time.

Long before man's coming, forests were under natural regulation in which forest conditions were created. Fires periodically devastated portions of forests. Insects killed trees singularly and in groups. Disease took a toll. Storms created blowdowns. The result was a diversity of successional stages. Wildlife adapted to these conditions. Thus, each stand structure provides habitat for a set of species that exploit the niches.

To a product-oriented manager, however, natural conditions were not ideal. Some intermediate-stocked stands eventually developed into merchantable sawtimber. But some areas either remained unstocked for years or were minimally stocked. Others were overstocked, and growth rates declined. Silvicultural manipulation was essential to maximize wood production.

Silviculture, the theory and practice of controlling the establishment, composition, and growth of forests, creates stand structures. Wildlife responds to structure more than to any other factor. So, forest management has significant impacts on wildlife. The challenge is to simultaneously meet timber and wildlife management objectives.

A manager can follow one of three options in formulating wildlife objectives: featured-species management, species richness management, or a combination. Regardless, vegetation is manipulated to provide habitats. Silviculturists must also manipulate the forest to maintain an acceptable flow of wood products.

To achieve wildlife and wood production goals, we deal with scheduling of silvicultural treatments, stand arrangements in time and space, stand conditions, treatment areas, and land type. Treatment timing allows flexibility in creating or maintaining stand conditions. Any treatment that accelerates or delays harvest beyond culmination of mean annual increment decreases timber production. Stands are arranged in time and space by timing silvicultural treatments. Arrangement is critical to assure habitat juxtaposition for wildlife species requiring two or more types. Species richness of ecotones can be controlled by stand arrangements.

Stand condition includes: structure, size, species composition, presence of disease or insects, and number of dead and dying trees. Stand condition is greatly influenced by regeneration technique, shrub and grass treatment, tree species favored in thinning, thinning extent or intensity, kind of thinning, and silvicultural system employed. The area size to be treated can be manipulated, usually by a regeneration unit's size. Completely forested land types can be enhanced in diversity by silvicultural treatment. But diversity in partially forested areas can be reduced by treatment.

Many combinations of timber and wildlife objectives and silvicultural options can be used to manage forest communities. Silvicultural prescriptions can be used to produce wood at a high percentage of biological potential while providing habitat. Trade-offs are mandatory and depend on management goals.

In some countries, these goals are prescribed by law and instituted through land-use planning. In such cases, it is not a question of producing both timber and wildlife--that is required by law. And, it is not a question of whether both can be produced--they can. But there must be a firm commitment and appropriate management skills among foresters and biologists to set clear objectives and make equitable trade-offs.

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COMMUNICATION IN ORCINUS ORCA (KILLER WHALE)

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Is there language, as we define it, in a species other than Homo sapien? For the past five years this has been the subject of my investigation with dolphins and specifically Orcinus orca, the killer whale.

When I decided to investigate this ponderous question I had to select a suitable species to work with. Two of the most desirable characteristics the study animals required were loquaciousness and boldness. A timid creature would be hard to approach and make the work extremely difficult. The loquacious nature of the dolphin immediately attracted me and I began to work with the bottlenose dolphin, Tursiops truncatus. However, due to the high frequency of their sounds and difficulties of approaching them in the wild I soon turned to their larger cousin, Orcinus orca.

My next step was to develop a working hypothesis and modus operandi. In examining our own language I realized that to try to correlate individual words and sounds with behaviors would prove fruit less. We do not jump, for example, when saying the word "jump". Nonetheless, during specific human activities key words or phrases are most often spoken than during other activities. For example upon greeting a person, words such as hello, fine, and good morning are likely to be uttered. If I recorded the sounds of a limited interactive group of people, such as a tribe, the words used during greeting would have a high probability of reoccurring. This is essentially what I have done with the killer whale. I am looking at the overall usage of sound, during specific behaviors, by one pod of whales.

My technique involves recording the underwater vocalizations of the whales on one track of an audio recorder while recording my voice notes on the second track. My voice notes give a detailed running account of the whale's behavior and the environmental conditions. In the laboratory, alphanumeric codes are assigned to each sound and behavior. Then, one track at a time, I log each sound and behavior into an Apple II microcomputer. Analysis involves 'calling up' all occurrences of each behavior state and then graphing the pattern of sound usage. The use of sound in different activity states is then compared both graphically and statistically.

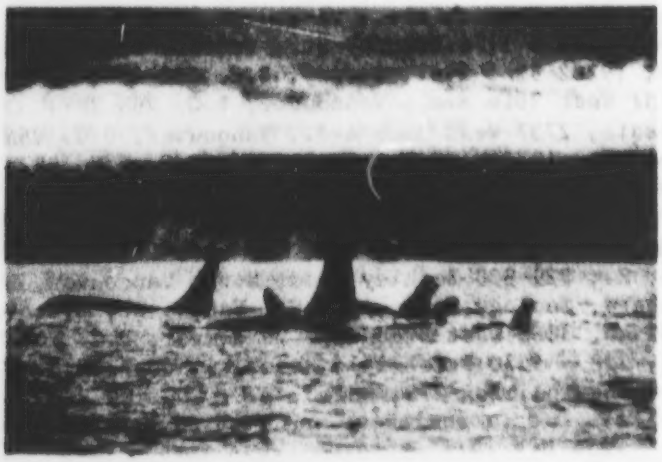
I began my orca research with a pair of captive whales at Marineland in Los Angeles. They are unique in several ways. The bull is the largest and possibly the oldest captive Orcinus. In itself the latter is not significant until one realizes that the killer whale does not reach maturity until its 12th to 14th year. The bull is estimated to be 15 or 16 years old and as such offers me an opportunity to study a mature subject, an aspect that is paramount to the scope of this investigation. A second unique opportunity provided by these particular whales has been the recording of the pregnancy, birth, and unfortunately the death of three offspring. Reproduction in captive animals indicates a high level of mental normality. Not only did the events surrounding the birth of the calves contribute enormously to my understanding of the social nature of orcas, but it also revealed that my study animals were in good mental health. Captive animals often display neurotic behavior and as my study involves correlating sounds and behaviors I needed the assurance that at least the majority of their behaviors were normal. Incidently, they are expecting another calf in the spring of 1982.

In 1979 I began a concurrent study of wild killer whales. While captivity offers a very intimate look at behavior it is exclusive of a wide variety of natural behaviors. As my study is concerned with the activities of one group of whales I traced the female's origin through capture records to A5 pod. A5 pod (named by M.A. Bigg, 1976) is a small group of whales inhabiting the waters off the northeastern coast of Vancouver Island.

During 1980 the focus of my work has shifted from the captive to the wild environment. Collecting data in the wild is very slow and it will be a few years before I have any conclusive results from the wild members of A5 pod. However, the captive study has revealed a tremendous correlation between usage of sound and behavior.

In addition, I am studying the structure and development of vocalization in a young captive whale at Sealand of the Pacific in Victoria, B.C. This study involves monthly recording sessions to document the rate at which the young whale acquires her repertoire of sounds from the other captive whale.

I am now certain Orcinus orca possesses a complex system of communication. I am also aware that it is a system very different than our own. Mapping this cetacean communication system is now underway as my occupational priority.



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